ITHACA ENERGY

Cambo Field Development

Environmental Statement | West of Shetland

OPRED Reference Number: ES/2026/022 | March 2026

Ithaca SP E&P Limited

ENVIRONMENTAL STATEMENT – SUBMISSION SUMMARY

THE OFFSHORE OIL AND GAS EXPLORATION, PRODUCTION, UNLOADING AND STORAGE (ENVIRONMENTAL IMPACT ASSESSMENT) REGULATIONS 2020

SUBMISSION OF AN ENVIRONMENTAL STATEMENT IN SUPPORT OF AN APPLICATION FOR THE CONSENT OF A PROJECT UNDER THE PETROLEUM ACT 1998 OR THE ENERGY ACT 2008

Section A: Administrative Information

A1 – Project Reference Number

Number ES/2026/022

A2 – Applicant Contact Details

Company name: Ithaca SP E&P Limited

Contact name: [redacted]

Contact title: Environmental Advisor

A3 – ES Contact Details (if different from above)

As above.

A4 – ES Preparation

Key expert personnel involved in the preparation of the ES:

Name	Company	Title	Relevant Qualifications/Experience
[redacted]	Ithaca SP E&P Limited	Environmental Advisor	Eighteen years working in the oil and gas industry, in both environmental consultancy and operator roles. Specialisms in Environmental Impact Assessment, Environmental Management and Risk Assessment. MSc Environmental Impact Assessment
[redacted]	Fugro GB Limited	Principal Environmental Consultant	Over twenty five years in environmental consultancy role for the offshore oil and gas industry and other marine industries. MSc Marine Resource Development and Protection BEng Environmental Technology
[redacted]	Fugro GB Limited	Senior Environmental Consultant	Fifteen years in environmental consultancy role, in which main specialisms have been environmental impact assessment and permitting applications. MSc Ecology

Name	Company	Title	Relevant Qualifications/Experience
			BSc (Hons) Zoology
[redacted]	Fugro GB Limited	Environmental Consultant	Four years in environmental consultancy role in which main specialisms have been environmental impact assessments and desktop studies. MSc Climate Change: Managing the marine environment BSc (Hons) Marine Science
[redacted]	Fugro GB Limited	Environmental Consultant	Two years in environmental consultancy role in which main specialisms have been permitting applications and desktop studies. MSc Marine Systems and Policies BSc Natural Sciences

A5 – Licence Details

a) **Licenses covering proposed activities**

Licence numbers: P1028 and P1189

b) **Licenses and current equity**

Company	Percentage Equity
Ithaca SP E&P Limited	70
Ithaca Energy (UK) Limited	30

Section B: Project Information

B1 - Nature of Project

a) Name of the project: Cambo Field Development

b) Name of the ES: As above

c) Brief description of the project:

Ithaca SP E&P Limited (an affiliate of Ithaca Energy (UK) Limited) and Ithaca Energy (UK) Limited (Ithaca Energy (UK) Limited and its affiliated companies being collectively referred to as "Ithaca Energy") propose to develop Cambo field to produce the oil and gas contained in the reservoir. The field will comprise nine production wells supported by four peripheral seawater injection wells. All reservoir fluids will be produced via three subsea drill centres connected to a new-build Floating Production, Storage and Offloading (FPSO) vessel. Consideration for an optional dedicated appraisal well will be given which could assist with the optimisation of the well locations in the southwest of the field. Oil will be exported via tandem offloading to a dynamically positioned export shuttle tanker. Produced gas will be used to meet the FPSO's power requirements with any excess conditioned for export via a Gas Export Pipeline (GEP) which ties into the Rosebank gas export system approximately 32.5 km to the northeast.

Ithaca Energy is currently planning to commence offshore development activities at the Cambo field in Q2 2028, with drilling operations beginning in Q3 2028. First oil is expected in Q4 2030. At present, it is anticipated that the Cambo field development will produce hydrocarbons until 2055.

B2 – Project Location

a) Offshore location of the main project elements

Location	Easting [m]	Northing [m]
DC1 Wells		
P2	437,258	6,743,305
P1	437,219	6,743,272
P22	437,291	6,743,243
P10	437,262	6,743,223
DC2 Wells		
P3	436,038	6,742,309
P7	436,096	6,742,250
P20	436,100	6,742,278
DC3 Wells		
P11	435,477	6,741,103
P21	435,440	6,741,123
Water injectors		
WI1	436,525	6,744,589
WI2	436,515	6,744,648
WI5	434,350	6,742,550
WI7 (field drawing)	440,826	6,742,180
Optional Appraisal Well		
Optional Stand Alone SW Appraisal	435,149	6,740,560

Notes:
The coordinates are based on the European Datum 1950 (ED 50) UTM Zone 30.

The proposed development is situated in United Kingdom Continental Shelf (UKCS) Blocks 204/4a, 204/5a, 204/5b, 204/9a, 204/10a, 205/1b and 205/2b, approximately 133 km to the west of the Shetland Islands from the Cambo FPSO and approximately 8 km to the UK/Faroe Island transboundary line. Water depths within the proposed Cambo field development range from 1,070 m Lowest Astronomical Tide (LAT) to 1,100 m LAT.

B3 – Previous Applications

2021 Application
Name of project: Cambo Phase 1 Field Development Environmental Statement. **Date of submission of ES:** 31st May 2021. **Identification number of ES:** D/4261/2021 The Environmental Statement (ES) Ref. D/4261/2021 was submitted under the offshore oil and gas exploration, production, unloading and storage (environmental impact assessment) regulations 2020 by Siccar Point Energy E&P Limited and Shell U.K. Limited.
2019 Application
Name of project: Cambo Phase 1 Field Development Environmental Statement. **Date of submission of ES:** 29th October 2019 **Identification number of ES:** D/4240/2019 The Environmental Statement (ES) Ref. D/4240/2019 was previously submitted under the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) and was awaiting approval at the end of 2020. However, the ES was required to be resubmitted following the replacement of these Regulations by the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020, and because the ES was not regarded as a transitional case under these Regulations.

Contents

Glossary 1

Abbreviations 1

Non-Technical Summary 1

The Environmental Assessment Process and Environmental Management 2

Net Zero Action Plan 3

The Proposed Operations 3

Option Selection 4

Local Environment 11

Environmental Surveys Relevant to the Proposed Cambo Development 11

Physical Environment 11

Biological Environment 12

Coastal Habitats 14

Protected Sites and Sensitive Habitats 15

Other Users of the Sea 17

Climate Change 17

Assessment of Potential Impacts 18

Physical Presence Impacts 18

Atmospheric Emissions 20

Drilling Discharges 23

Produced Water and Marine Discharges 24

Underwater Noise Impacts 26

Waste Management 27

Accidental Events 28

Overall Conclusions 32

1. Introduction **1-1**

1.1 Background to the Proposed Cambo Field Development 1-3

1.2 Legislative Framework 1-5

1.2.1 The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 1-5

1.2.2 The Offshore Petroleum and Pipelines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017 1-5

1.2.3 The Climate Change Act 2008 1-6

1.2.4 The North Sea Transition Deal 1-6

1.2.5 Offshore Chemicals Regulations 2002 (as amended) 1-6

1.2.6 The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended) 1-7

1.2.7 The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) 1-7

1.2.8 Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) 1-8
1.2.9 The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019 1-8
1.2.10 Petroleum Act 1998 (as amended) 1-9
1.2.11 The Energy Act 2008 (as amended) 1-9
1.2.12 The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 (as amended) 1-10
1.2.13 The Greenhouse Gas Emissions Trading Scheme Order 2020 1-10
1.2.14 The Offshore Installations (Offshore Safety Directive (Safety Cases etc.) Regulations 2015 1-11
1.2.15 UK Marine and Coastal Access Act 2009 1-11
1.2.16 Marine Strategy Framework Directive 1-11
1.2.17 The Scottish National Marine Plan 1-12
1.3 Environmental Impact Assessment (EIA) Process 1-12
1.3.1 Information Gathering 1-12
1.3.2 Commissioning Specialist Studies 1-13
1.3.3 Identification Potential Environmental Effects 1-13
1.3.4 Assessment of Potentially Significant Environmental Effects 1-13
1.3.5 Development of Mitigation Measures 1-14
1.3.6 Reporting of the Outcome of the EIA Process 1-14
1.4 Environmental Management 1-15
1.4.1 Environmental Management During Operation of the proposed Cambo Field Development 1-15

2. Net Zero Action Plan 2-1
2.1 Legislative and Regulatory Framework 2-1
2.2 Emissions Baseline and Performance 2-2
2.3 Emissions Reporting and Governance 2-2
2.4 Environmental Management System 2-3
2.5 Net Zero Targets and Objectives 2-4
2.6 Emissions Reduction Action Plans 2-4
2.6.1 Ithaca Energy's Emissions Reduction Action Plan (ERAP) 2-4
2.6.2 Low Carbon Power 2-5
2.6.3 Alternative Fuels 2-6
2.7 Cambo Field Development 2-6

3. Option Selection 3-1
3.1 Introduction 3-1
3.1.1 Legislative Requirements 3-1
3.1.2 Planning the Proposed Cambo Field Development - Background 3-2
3.1.3 Option Screening and Selection Process 3-3
3.1.4 Project Value Drivers and Decision Criteria 3-3
3.1.5 Other Factors Influencing Concept Selection 3-4
3.2 Development Justification 3-5

3.2.1 Critical Success Factors and Project Objectives 3-6
3.3 Option Identification and Selection 3-7
3.3.1 Field Development Concept 3-7
3.3.2 Drilling/Wells 3-10
3.3.3 Reservoir Management 3-15
3.3.4 Production Facilities 3-26
3.3.5 Facilities Design 3-27
3.4 Summary 3-51

4. Project Description 4-1
4.1 Cambo Field Development Overview 4-1
4.2 Crude Characteristics and Production Rate Forecast 4-2
4.3 Project Overview and Schedule 4-3
4.4 Drilling Operations 4-5
4.4.1 The Mobile Drilling Unit, Other Vessels and Helicopters 4-7
4.4.2 Well Engineering 4-9
4.4.3 Mud System and Cuttings Discharge 4-11
4.4.4 Cementing Operations Chemicals 4-14
4.4.5 Chemical additives used during drilling cementing operations 4-15
4.5 Subsea Infrastructure 4-16
4.5.1 Infield Subsea Infrastructure 4-16
4.5.2 Subsea Installation and Commissioning 4-21
4.5.3 SHEFA-2 4-21
4.5.4 Gas Export Pipeline and Associated Subsea Infrastructure 4-22
4.5.5 Temporary Seabed Obstructions 4-24
4.5.6 Subsea Installation Support Vessels 4-26
4.5.7 Inspection and Maintenance 4-26
4.6 Floating Production, Storage and Offloading (FPSO) 4-27
4.6.1 FPSO Concept 4-27
4.6.2 Design Parameters 4-28
4.6.3 Mooring and Installation 4-28
4.6.4 Facilities Overview 4-31
4.6.5 Oil Processing 4-32
4.6.6 Gas Processing 4-33
4.6.7 Produced Water Treatment 4-35
4.6.8 Flaring and Venting 4-36
4.6.9 Sand Production and Disposal 4-37
4.6.10 Oil Storage and Offloading 4-37
4.6.11 Utility Systems 4-38
4.6.12 Fuel Use during Production 4-42
4.7 Decommissioning 4-42

5. Local Environment 5-1
5.1 Data Sources 5-3
5.1.1 Environmental Surveys Relevant to the Proposed Cambo Field Development 5-3

5.2 Site Specific Surveys 5-7
5.3 Physical Environment 5-7
5.3.1 Hydrography 5-7
5.3.2 Meteorology 5-10
5.3.3 Bathymetry 5-10
5.3.4 Seabed Features 5-12
5.3.5 Seabed Sediments 5-12
5.3.6 Sediment Chemistry 5-17
5.4 Biological Environment 5-21
5.4.1 Benthos 5-21
5.4.2 Plankton 5-23
5.4.3 Fish 5-24
5.4.4 Marine Mammals 5-29
5.4.5 Seabirds 5-37
5.5 Coastal Habitats 5-43
5.5.1 Shetland and Orkney Islands 5-43
5.5.2 UK Mainland 5-45
5.5.3 Faroe Islands 5-46
5.5.4 Norway 5-46
5.5.5 Iceland 5-46
5.6 Protected Sites and Sensitive Habitats 5-46
5.6.1 Coastal Conservation Areas 5-46
5.6.2 Offshore Conservation Areas 5-48
5.6.3 Sensitive Habitats 5-50
5.7 Other Users of the Sea 5-50
5.7.1 Commercial Fisheries 5-50
5.7.2 Aquaculture 5-66
5.7.3 Oil and Gas Infrastructure 5-67
5.7.4 Shipping 5-70
5.7.5 Military Activity 5-72
5.7.6 Wrecks and Archaeology 5-72
5.7.7 Submarine Cables 5-72
5.7.8 Renewable Energy Installations and Gas Storage/Carbon Capture and Storage (CCS) Areas 5-72
5.8 Climate Change 5-72
5.8.1 The Greenhouse Effect 5-73
5.8.2 Global GHG Emissions – Current Status and Trend 5-73
5.8.3 Managing Climate Change Globally – The Paris Agreement 5-75
5.8.4 Managing Climate Change in the UK 5-77
5.8.5 Projected Global GHG Emissions 5-79
5.8.6 Global Climate Change Effects 5-82
5.8.7 Climate Change Effects in the UK 5-88
5.9 Summary 5-90

6. Identification of Impacts 6-1
6.1 Informal Stakeholder Consultation 6-1
6.2 The ENVID Workshops 6-7
6.2.1 The ENVID Workshop Findings 6-8
6.3 National Policies and Guidance 6-9
6.3.1 Scottish National Marine Plan Requirements 6-9
6.3.2 Oil and Gas Policies 6-12
6.3.3 Feature Activity Sensitivity Tool (FeAST) 6-13
6.4 Concerns Identified for Further Assessment 6-14

7. Impact Assessment Methodology 7-1
7.1 Introduction 7-1
7.2 Source-Pathway-Receptor Analysis 7-2
7.3 Assessment of Effects and Their Significance 7-3
7.3.1 Characterising and Assessing the Magnitude of Effects 7-3
7.3.2 Valuation of Receptors 7-6
7.3.3 Assessment of Significance of Effects 7-8
7.3.4 Frequency, Duration and Likelihood of Occurrence 7-10
7.4 Assessing Multiple Options 7-11
7.5 In-Combination, Cumulative and Transboundary Effects 7-11
7.6 Mitigation and Monitoring 7-12

8. Physical Presence 8-1
8.1 Impacts on Seabed and Associated Communities 8-1
8.1.1 Physical Extent of the Area Affected by the Proposed Operations 8-1
8.1.2 Potential Effects on Seabed Communities 8-5
8.2 Impacts on Other Users of the Sea 8-10
8.2.1 Impacts on Commercial Fisheries 8-10
8.2.2 Impacts on Shipping and Navigation 8-11
8.2.3 Impacts on Military Operations 8-12
8.3 Best Practice Measures 8-12
8.4 In-combination, Cumulative and Transboundary Impacts 8-13
8.5 Conclusions 8-13

9. Atmospheric Emissions 9-1
9.1 Quantification of Atmospheric Emissions 9-6
9.1.1 Data Sources and Uncertainty 9-6
9.1.2 Quantification of Drilling Emissions 9-7
9.1.3 Quantification of Emissions during the Installation of SPS/SURF, FPSO and Pipeline 9-7
9.1.4 Quantification of Emissions from Well clean-up and Commissioning flaring 9-8
9.1.5 Quantification of Emissions During Operations / Production 9-9
9.1.6 Estimation of Downstream Combustion Emissions of Produced Hydrocarbons (Scope 3, Category 9, 10 and 11 emissions) 9-12
9.1.7 Summary of all Emissions Combined over the Cambo Life of Field 9-14

9.2 Putting the Cambo Emissions into Context 9-15
9.2.1 UK Carbon Budgets 9-19
9.2.2 Global CO_2 Targets 9-21
9.3 Assessment of Localised and Regional Air Pollution Impacts 9-22
9.4 Cumulative Global Climate Change Impacts 9-23
9.5 Mitigation Measures 9-24
9.6 Conclusions 9-26

10. Drilling Discharges 10-1
10.1 Description and Quantification of Discharges 10-1
10.1.1 Mud and Cuttings 10-1
10.1.2 Payzone and Associated Drilling Fluids 10-2
10.1.3 Cement 10-2
10.2 Impacts from Water Based Muds (WBM) and Cuttings Discharges 10-3
10.2.1 Physical Extent of Discharges 10-3
10.2.2 Effects on Benthic Communities 10-15
10.3 Best Practice 10-18
10.4 In Combination, Cumulative and Transboundary Impacts 10-19
10.5 Conclusion 10-19

11. Produced Water and Marine Discharges 11-1
11.1 Produced Water Discharge 11-1
11.2 Treatment of the Produced Water 11-1
11.3 Produced Water Modelling 11-2
11.3.1 Ambient Characteristics 11-2
11.3.2 Discharge Characteristics and Scenarios 11-3
11.4 Model Results 11-4
11.4.1 Worst-case Scenario 11-5
11.4.2 Typical Scenario 11-9
11.5 Ballast Water 11-12
11.5.1 Marine Invasive Non-Native Species (MINNS) 11-12
11.6 Impacts on Benthic and Water Column Communities 11-13
11.6.1 Produced Waters 11-13
11.6.2 Impacts on Marine Protected Areas 11-15
11.6.3 Ballast Waters 11-15
11.7 Best Practice 11-16
11.8 In-combination, Cumulative and Transboundary Impacts 11-16
11.9 Conclusion 11-17

12. Underwater Noise 12-1
12.1 Quantification of Noise 12-2
12.1.1 Ambient Noise 12-2
12.1.2 Acoustic Characteristics of Activities in the Cambo Field 12-4
12.1.3 Underwater Sound Behaviour 12-6

12.1.4 Overview of Sound Level Metrics 12-8
12.2 Impacts from Underwater Noise 12-10
12.2.1 Impacts of Noise on Marine Mammals 12-11
12.2.2 Impacts on Fish 12-18
12.3 Assessment of the Requirement for a Wildlife Disturbance Licence 12-23
12.4 In-combination, Cumulative and Transboundary Impacts 12-26
12.5 Mitigation Measures 12-27
12.6 Conclusions 12-27

13. Waste Management 13-1
13.1 The Waste Hierarchy 13-1
13.2 Waste Disposal Management 13-2
13.2.1 Waste Sources and Management 13-3
13.3 Mitigation Measures and Best Practice 13-5
13.4 Conclusion 13-5

14. Accidental Events 14-1
14.1 Sources of Hydrocarbon Spill 14-1
14.1.1 Potential Crude Oil Spillages 14-2
14.1.2 Potential Diesel (Fuel Oil) Spillages 14-2
14.1.3 Other Potential Sources of Oil 14-2
14.2 Likelihood of a Hydrocarbon Spill from the MODU 14-3
14.2.1 Uncontrolled Well Blow-out 14-4
14.2.2 Diesel Spills 14-5
14.3 Likelihood of a Hydrocarbon Spill from the FPSO 14-5
14.4 The Fate and Behaviour of a Hydrocarbon Spill at Sea 14-6
14.4.1 Oil Spill Movement 14-7
14.4.2 The Weathering Process 14-7
14.4.3 Oil Spill Modelling 14-10
14.5 Potential Environmental Impacts 14-21
14.5.1 Impacts on Marine Life 14-21
14.5.2 Impacts on Coastal and Inshore Habitats 14-27
14.5.3 Impacts on Other Users of the Sea 14-30
14.5.4 In-combination, Cumulative and Transboundary Effects 14-31
14.6 Potential for a Major Environmental Incident 14-32
14.6.1 MEI Assessment Methodology 14-32
14.6.2 Sea Surface Oiling 14-40
14.6.3 Shoreline Oiling 14-41
14.6.4 Conclusion 14-42
14.7 Mitigation Measures 14-42
14.7.1 Preventative Measures 14-42
14.7.2 Action to Stop a Subsea Spill During Drilling with the MODU 14-44
14.7.3 Oil Spill Response 14-45

14.7.4 Oil Spill Response Strategies 14-47
14.7.5 Liability and Insurance 14-48
14.8 Catastrophic Loss of the FPSO, MODU, a Vessel or the Helicopter 14-48
14.9 Resilience to Natural Disasters and Climate Change 14-49
14.10 Conclusions 14-50

15. Conclusions 15-1
15.1 Physical Presence 15-2
15.2 Atmospheric Emissions 15-3
15.3 Drilling Discharges 15-3
15.4 Produced Water and Marine Discharges 15-4
15.5 Underwater Noise and Wildlife Disturbance 15-5
15.6 Waste Management 15-5
15.7 Accidental Events 15-6
15.8 Overall Conclusions 15-7

16. References 16-1

Tables

Table 1.1: History of the Cambo field 1-4
Table 3.1: Decision criteria and project goals and value drivers for the Cambo field development 3-4
Table 3.2: Rationale summary for rejection of field development concept alternatives 3-9
Table 3.3: Rationale summary for rejection of reservoir depletion strategy 3-16
Table 3.4: Rationale summary for rejection of artificial lift strategy 3-17
Table 3.5: Rationale summary for rejection of reservoir souring management techniques 3-22
Table 3.6: Rationale summary for reinjection of water nutrient removal techniques 3-23
Table 3.7: Rationale summary for host facility options 3-27
Table 3.8: Rationale summary for subsea infrastructure options 3-29
Table 3.9: Rationale summary for rejection of discounted hull options 3-33
Table 3.10: Rationale summary for rejection of power generation options 3-35
Table 3.11: Rationale summary for rejection of cargo storage tank blanketing options 3-44
Table 3.12: Rationale summary for rejection of produced gas disposal options 3-46
Table 3.13: Rationale summary for rejection of alternative gas export routes 3-50
Table 4.1: Cambo oil characteristics 4-2
Table 4.2: Forecast production from the Cambo field 4-2
Table 4.3: Indicative timetable for the proposed Cambo field development 4-5
Table 4.4: Vessel requirements for drilling using CAN-ductors for all wells and installation of Xmas trees 4-8
Table 4.5: Vessel requirements during conventional drilling and installation of Xmas trees (no CAN-ductors) 4-8
Table 4.6: Cuttings and WBM volumes for the largest production well (P10) 4-13
Table 4.7: Cuttings and WBM volumes for the optional appraisal well 4-13
Table 4.8: Cuttings and WBM volumes for re-spudding any of the wells 4-14
Table 4.9: Indicative locations and seabed footprints of permanent infield subsea structures 4-18
Table 4.10: Seabed footprint of all infield umbilicals, risers and flowlines 4-20
Table 4.11: Seabed footprint of fibre optic cable 4-22
Table 4.12: Seabed footprints of temporary infield seabed obstructions 4-24
Table 4.13: Location and seabed footprints of GEP infrastructure 4-25
Table 4.14: Vessel requirements and estimated fuel consumption during SPS/SURF installation 4-26
Table 4.15: Design parameters for production facilities onboard the FPSO 4-28
Table 4.16: Vessel requirements and estimated fuel consumption during FPSO installation 4-29
Table 4.17: Cambo FPSO power generation 4-41
Table 5.1: Summary of previously obtained survey data in the area of proposals and wider region 5-4
Table 5.2: Chemical parameters previously sampled in the proposed field development 5-18
Table 5.3: Summary of sediment hydrocarbon analysis for the Cambo field development 5-20
Table 5.4: Summary of sediment aromatic hydrocarbon analysis for the Cambo field development 5-21
Table 5.5: Shark and skate species likely present within the area of proposals based on existing literature 5-29
Table 5.6: Distribution and abundance of whales, dolphins and porpoises in the Faroe-Shetland Channel 5-31
Table 5.7: Density of species of cetaceans within and immediately surrounding the Cambo field development 5-33

Table 5.8: Seabirds likely present within the proposed Cambo field development 5-38
Table 5.9: Seabird sensitivity to surface oil pollution in the vicinity of the Cambo field development 5-41
Table 5.10: Annual fishing effort for ICES rectangles 50E6, 51E6, 49E5 and 49E6 for the period 2015 – 2024 (Marine Directorate, 2025c) 5-58
Table 5.11: Monthly fishing effort for ICES rectangles 50E6, 49E5, and 49E6 for the period 2015 – 2024 (Marine Directorate, 2025c) 5-59
Table 5.12: Monthly fish landings (tonnes) by UK vessels between 2015 and 2024 in ICES rectangle 50E6 (Marine Directorate, 2025c) 5-60
Table 5.13: Landing values (£) for fish caught in ICES rectangles 50E6, 49E5, and 49E6 (Marine Directorate, 2025c) 5-62
Table 5.14: Total global GHG emissions 5-75
Table 5.15: UK Carbon Budgets 5-78
Table 5.16: Classification of emissions scenarios into global warming levels 5-80
Table 5.17: Projected changes in extremes frequency and intensity with every additional increment of global warming 5-88
Table 5.18: Climate change effects in the UK 5-89
Table 5.19: Seasonal variation of key environmental sensitivities 5-90
Table 6.1: Collated scoping comments relating to the assessment of potentially significant impacts 6-2
Table 6.2: ENVID workshop scoping matrix 6-7
Table 7.1: Magnitude of effect value and description 7-4
Table 7.2: Environmental and socio-economic receptor value 7-6
Table 7.3: Determining significance of adverse effects 7-8
Table 7.4: Effect significance categories 7-9
Table 7.5: Likelihood of an accidental event 7-10
Table 7.6: Determining final effect significance 7-11
Table 8.1: Summary of the worst-case seabed footprint of the proposed GEP 8-2
Table 8.2: Summary of worst-case footprint of proposed infield infrastructure 8-3
Table 8.3: Summary of worst-case footprint of all in field umbilicals, risers and flowlines 8-3
Table 8.4: Worst-case footprint of suction anchor piles and anchor chains 8-4
Table 8.5: Worst-case footprint of temporary seabed obstructions 8-5
Table 8.6: Worst-case footprint of FOC 8-5
Table 8.7: Summary of benthic effects 8-6
Table 9.1: List of Scope 3 categories (adapted from GHG Protocol, 2011) 9-2
Table 9.2: Environmental effects and GWP of atmospheric emissions 9-5
Table 9.3: Estimated emissions during drilling and well completion 9-7
Table 9.4: Estimated emissions during subsea installation 9-8
Table 9.5: Estimated emissions during commissioning (mid-case) 9-8
Table 9.6: Estimated upstream production emissions over the life of field (Scope 1 and Scope 3, Categories 4 and 6) 9-9
Table 9.7: Cambo downstream Scope 3 emissions 9-13
Table 9.8: Summary of all CO_2e emissions combined over life of field 9-14
Table 9.9: Cambo emissions in relation to UK Carbon Budgets 9-20
Table 10.1: Modelling scenarios 10-3
Table 10.2: Topographical metrics of combined cuttings piles for the planned release scenario 10-7

Table 10.3: Topographical metrics of combined cuttings piles for the spread release scenario 10-10
Table 10.4: Approximate cuttings and cement accumulation for all visible cones and distances from Cambo 4 well 10-13
Table 11.1: Worst-case and average conditions of the receiving waters considered in the updated (visual plumes) modelling study 11-3
Table 11.2: Discharge parameters for the different scenarios 11-4
Table 11.3: Worst-case current conditions: plume characteristics at the end of near-field dispersion phase 11-7
Table 11.4: Worst-case current conditions: minimum distances for prescribed dilutions 11-7
Table 11.5: Typical current conditions: plume characteristics at the end of near-field dispersion phase 11-10
Table 11.6: Typical current conditions: minimum distances for prescribed dilutions 11-10
Table 12.1: Examples of natural sounds in the marine environment 12-2
Table 12.2: Sound sources from various maritime activities 12-3
Table 12.3: Functional hearing groups for marine mammals potentially present at the Cambo field development 12-11
Table 12.4: PTS and TTS onset thresholds for impulsive and non-impulsive sounds (NOAA, 2024). 12-13
Table 12.5: PTS and TTS noise impact ranges for marine mammals 12-14
Table 12.6: Fish functional hearing groups (Popper et al., 2014) 12-19
Table 12.7 Categories of noise impact on fish (Popper et al., 2014) 12-19
Table 12.8: Fish impact criteria for impact pile driving sounds (Popper et al., 2014) 12-20
Table 12.9: Fish impact criteria for shipping and continuous sounds (Popper et al., 2014) 12-21
Table 12.10: PMI, RI, and TTS noise impact ranges (in meters) for fish as a result of exposure to sounds from the VSP survey, drilling, and vessel activity in the Cambo field. 12-22
Table 12.11: Numbers of cetaceans present within the disturbance zone of the potential VSP survey operations 12-24
Table 14.1: Well blow-out modelling parameters 14-11
Table 14.2: Well blow-out modelling results 14-12
Table 14.3: Complete loss of FPSO inventory spill modelling parameters 14-16
Table 14.4: Complete loss of FPSO inventory spill modelling result 14-17
Table 14.5: Consequence assessment methodology based on Patin (2004) 14-33
Table 14.6: Protected sites which may be impacted by a large oil spill from the proposed Cambo field development 14-36
Table 14.7: Environmental consequence assessment for sea surface oiling 14-40
Table 14.8: Environmental consequence assessment for shoreline oiling 14-41

Figures

Figure 1: Location of the proposed Cambo field development 2
Figure 2: Proposed Cambo field development infrastructure 5
Figure 3: Environmental survey locations relevant to the proposed Cambo field development 12
Figure 4: Offshore and coastal conservation areas in the area of the proposed Cambo development 16
Figure 1.1: Location of the proposed Cambo field development 1-2
Figure 3.1: Ithaca Energy stage gate process 3-1
Figure 3.2: Key factors influencing concept selection 3-5
Figure 3.3: Option decision tree for Cambo field development justification 3-6
Figure 3.4: Critical success factors and project objectives 3-7
Figure 3.5: Option decision tree for Cambo field development concept 3-7
Figure 3.6: Option decision tree for Cambo MODU selection 3-10
Figure 3.7: Option decision tree for Cambo well type 3-11
Figure 3.8: Option decision tree for Cambo well construction 3-13
Figure 3.9: Option decision tree for Cambo drill fluids and cuttings disposal 3-14
Figure 3.10: Option decision tree for Cambo reservoir management depletion strategy 3-15
Figure 3.11: Option decision tree for Cambo reservoir management artificial lift strategy 3-16
Figure 3.12: Option decision tree for Cambo produced water management 3-18
Figure 3.13: Option decision tree for Cambo reservoir souring management 3-25
Figure 3.14: Option decision tree for Cambo host facilities 3-26
Figure 3.15: Option decision tree for Cambo subsea infrastructure 3-28
Figure 3.16: Option decision tree for Cambo riser type 3-29
Figure 3.17: Restrained lazy wave riser configuration 3-30
Figure 3.18: Option decision tree for Cambo FPSO hull type 3-30
Figure 3.19: Option decision tree for Cambo primary power source 3-34
Figure 3.20: Option decision tree for flaring and venting at Cambo 3-42
Figure 3.21: Option decision tree for Cambo FPSO cargo storage tank blanketing 3-43
Figure 3.22: Option decision tree for oil export from the Cambo FPSO 3-44
Figure 3.23: Option decision tree for disposal of excess produced gas from the Cambo field 3-45
Figure 3.24: Gas export tie-in options 3-47
Figure 4.1: Production profile of the proposed Cambo field development 4-3
Figure 4.2: Indicative overview of the proposed Cambo field development layout (not to scale) 4-4
Figure 4.3: Location of proposed wells 4-6
Figure 4.4: Proposed well design 4-9
Figure 4.5: CAN-ductor for the previously drilled Cambo 5Y well on the quayside, awaiting deployment 4-10
Figure 4.6: CAN-ductor for the previously drilled Cambo 5Y well installed on the seabed 4-11
Figure 4.7: Subsea schematic of the proposed Cambo field development 4-16
Figure 4.8: Example of a typical Xmas tree 4-17
Figure 4.9: Proposed Cambo field development and gas export pipeline to Rosebank 4-23
Figure 4.10: Illustrative example of a suction anchor. 4-25
Figure 4.11: Proposed Cambo field development layout 4-30
Figure 4.12: Cambo process facilities overview 4-31

Figure 5.1: Location of the proposed Cambo field development 5-2
Figure 5.2: Previously obtained data in relation to the area of proposals 5-6
Figure 5.3: Water masses in the Faroe-Shetland Channel (Adapted from Berx, 2012) 5-8
Figure 5.4: Annual mean significant wave height and wave direction in the area of proposals (Fugro Metocean Planner, 2025b) 5-9
Figure 5.5: Mean annual wind speed and direction in the area of proposals (Fugro Metocean Planner, 2025b) 5-10
Figure 5.6: Survey area bathymetry and completed environmental sampling locations in 2025 (Fugro, 2025a) 5-11
Figure 5.7: Seabed features in the vicinity of the proposed Cambo field development 5-13
Figure 5.8: Seabed sediments in the vicinity of the proposed Cambo field development 5-14
Figure 5.9: Image from survey transect TR01B and TR08 showing muddy sand/sandy mud with pebbles, cobbles and boulder 5-15
Figure 5.10: Completed environmental transects and EUNIS habitat overlain on a side scan sonar mosaic (Fugro, 2025a) 5-16
Figure 5.11: Example AUV pictures obtained from the seabed sediments found within the area of proposals (Fugro, 2025a) (muddy sand/sandy mud (left pic) and bedrock (right pic) 5-22
Figure 5.12: Taxonomic groups (Fugro, 2025d) 5-23
Figure 5.13: Zonation of pelagic and demersal fish assemblage in the Faroe-Shetland Channel (Sources: Gordon & Hunter, 1994) 5-25
Figure 5.14: Fish spawning and nursing areas in the area of proposals 5-27
Figure 5.15: Estimated mean number of seals in the vicinity of the Cambo field development 5-35
Figure 5.16: Hooded seal range (source: NAMMCO, 2021) 5-36
Figure 5.17: Seabird sensitivity to surface oil pollution in the vicinity of the Cambo field development 5-42
Figure 5.18: Conservation areas 5-49
Figure 5.19: ICES rectangles overlapping with proposed Cambo field development 5-51
Figure 5.20: Total annual landings and effort from ICES rectangles 50E6, 51E6, 49E5 and 49E6 for the period 2015 – 2024 (Marine Directorate, 2025c). 5-52
Figure 5.21: Fishing intensity in the vicinity of the Cambo field development 5-53
Figure 5.22: Fish landings in tonnes per species per country excluding UK for ICES Areas 27.5.b.1.b and 27.4.a across 2013-2016 (ICES, 2025) 5-55
Figure 5.23: Fish landings in tonnes per species per country excluding UK for ICES Areas 27.5.b.1.b and 27.4.a across 2017-2020 (ICES, 2025) 5-56
Figure 5.24: Fish landings in tonnes per species per country excluding UK for ICES Areas 27.5.b.1.b and 27.4.a across 2021-2023 (ICES, 2025) 5-57
Figure 5.25: Average demersal value (£) and landings (tonnes) in the vicinity of the Cambo field development between 2015 and 2024 5-63
Figure 5.26: Average pelagic value (£) and landings (tonnes) in the vicinity of the Cambo field development between 2015 and 2024 5-64
Figure 5.27: Average shellfish value (£) and landings (tonnes) in the vicinity of the Cambo field development between 2015 and 2024 5-65
Figure 5.28: Aquaculture sites 5-68
Figure 5.29: Oil and gas and other infrastructure 5-69
Figure 5.30: Location of shipping route within 10 nm of the Cambo field (Anatec, 2025) 5-70
Figure 5.31: Annual shipping route density in the vicinity of the Cambo field development 5-71

Figure 5.32: Global greenhouse gas emissions (source: IPCC, 2023) 5-74
Figure 5.33: Monthly carbon dioxide in the atmosphere (Met Office, 2025) and Global Warming Increase (Smith et al., 2024 in CCC, 2025) 5-75
Figure 5.34: Projected range and progression of emission levels according to NDCs (Source: UNFCCC, 2024) 5-77
Figure 5.35: UK Carbon Budgets 5-79
Figure 5.36: Five potential future emission scenarios and resulting atmospheric CO_2 levels 5-81
Figure 5.37: Synthesis of observed climate change effects to date around the world (IPCC, 2023) 5-82
Figure 5.38: Observed impacts and related losses and damages of climate change to date (IPCC, 2023) 5-83
Figure 5.39: Global surface temperature change relative to the period 1850–1900 (Source: IPCC, 2021) 5-84
Figure 5.40: Global mean sea level change relative to 1900 (Source: IPCC, 2021) 5-85
Figure 5.41: Global ocean surface pH (a measure of acidity) (Source: IPCC, 2021) 5-86
Figure 5.42: September Arctic sea ice area (Source: IPCC, 2021) 5-87
Figure 7.1: Environmental Impact Assessment methodology 7-2
Figure 9.1: Greenhouse gas emissions and intensity for the Cambo field 9-11
Figure 9.2: Greenhouse gas intensity from all UKCS oil and gas installations in 2024 (NSTA, 2025a) 9-12
Figure 9.3: Emissions from UK oil and gas production (Source: NSTA, 2025b) 9-16
Figure 9.4: Projected gas requirements for the UK (NSTA, 2024) 9-17
Figure 9.5: Projected oil requirements for the UK (NSTA, 2024) 9-18
Figure 9.6: Current trend and projected upstream CO_2 emissions from the UK upstream oil & gas industry (Source: NSTA, 2025b) 9-19
Figure 9.7: Comparison of current global NDCs in relation to the IFCC AR6 SSP pathways (UNFCCC, 2024) 9-22
Figure 10.1: Planned release scenario for P10 well 10-5
Figure 10.2: Spread release scenario for P10 well 10-6
Figure 10.3: Maximum Anticipated Thickness of Deposition for All Wells (Planned Release Scenario) 10-8
Figure 10.4: Maximum anticipated extent of deposition for all wells (planned release scenario) 10-9
Figure 10.5: Maximum anticipated extent of deposition for all wells (spread release scenario) 10-11
Figure 10.6: Maximum anticipated extent of deposition for all wells (spread release scenario) 10-12
Figure 11.1: Simulated worst-case depth, dilution and distance profiles for produced water discharges at the proposed Cambo field development 11-6
Figure 11.2: Worst-case rates of dilution and distances over which these are forecast to be achieved for simulated discharges of produced water from the proposed Cambo field development 11-8
Figure 11.3: Simulated depth, dilution and distance profiles for produced water discharges at the proposed Cambo field development under typical conditions 11-9
Figure 11.4: Dilution and distances over which these are forecast to be achieved for simulated discharges of produced water from the proposed Cambo field development under typical conditions 11-12
Figure 12.1: Ambient noise power spectral density in the open ocean. Adapted from NRC, 2003. 12-4

Figure 12.2: Depth and frequency averaged propagation loss in clay (light grey), silt (dark grey), and sand (black) for a 1,000 m water depth. The curves are averaged over the frequency range of 16 Hz to 2 kHz. The blue curve shows the spherical spreading law (eq. 1). 12-8
Figure 13.1: Waste hierarchy 13-2
Figure 14.1: Oil spills on the UKCS from MODUs between 1990 and 2024 (Fugro, 2025c) 14-3
Figure 14.2: Percentage of hydrocarbon spills form MODUs by size, between 1990 and 2024 (Fugro, 2025c) 14-4
Figure 14.3: Oil spills on the UKCS from FPSOs between 1990 and 2024 (Fugro, 2025c) 14-6
Figure 14.4: Percentage of hydrocarbon spills from FPSO by size between 1990 and 2024 (Fugro, 2025c) 14-6
Figure 14.5: Fate and behaviour of spilled oil at sea 14-8
Figure 14.6: Well blow-out modelling: arrival time plot (OSRL, 2020a) 14-13
Figure 14.7: Well blow-out modelling: probability of surface oil (OSRL, 2020a) 14-14
Figure 14.8: Vertical movement of Cambo crude oil plume (OSRL, 2018) 14-15
Figure 14.9: Complete loss of FPSO inventory spill modelling: arrival time plot (OSRL, 2020b) 14-19
Figure 14.10: Complete loss of FPSO inventory spill modelling: probability of surface oil (OSRL, 2020b) 14-20
Figure 14.11: Maximum potential surface or shoreline oiling from an uncontrolled well blow-out (a) or crude oil storage tank rupture (b) overlain with protected area (OSRL, 2020a, 2020b; NatureScot, 2023; JNCC, 2025) 14-35

Appendices

1. Summary of Legislation
2. Commitments Register
3. ENVID Matrices
4. Summary of Scoping Feedback
5. Production Profiles

Glossary

Ambient Noise	Ambient or background noise consists of a range of individual sound sources, which can be both natural and manmade (anthropogenic)
Annex I habitat	A rare or characteristic habitat which is affords protection under on the EU Habitats Directive.
Annex II species	Animal or plant species requiring designation of Special Areas of Conservation under the EU Habitats Directive.
Annex IV species	Animal or plant species in need of strict protection under the EU Habitats Directive.
Annulus	The space between wellbore and casing.
Anthropogenic emissions	Emissions of greenhouse gases, greenhouse gas precursors, and aerosols caused by human activities. These activities include the burning of fossil fuels, deforestation, land use changes, livestock production, fertilization, waste management, and industrial processes.
Appraisal well	A well drilled after a discovery well to gain more information on the reservoir.
Atmospheric emissions	A collective term for gases and particulates released to the atmosphere.
Attenuation Loss	The physical processes in the sea that distort the mathematical spreading laws relating to sound.
Backfilling	Backfilling is the process of refilling an excavated hole.
Baleen whales	Whales of the suborder Mysticeti. They have plates of whalebone (a baleen) along the upper jaw for filtering plankton from the water.
Barite	Barium sulphate ($BaSO_4$).
Bathymetry	The measurement of underwater depth in ocean, seas or lakes.
Benthic	Of or relating to the seabed.
Benthos	Animals that occur on or in the seabed.
Biota	The flora or fauna occurring in a particular area.
Biotope	The region of a habitat associated with a particular ecological community.
Block	Sub-division of territorial seas for the purpose of licensing to a company or group of companies for exploration and production rights. A UK block is approximately 200 to 250 km^2.
Blowout	A blowout occurs when gas, oil or saltwater escapes in an uncontrolled manner from a well.
Blowout preventer	A hydraulically operated wellhead device that can be actuated to close a well in order to prevent an uncontrolled release of fluids (a blow-out).
BOP Hopping	The process of moving the BOP directly from one wellhead to another without recovering it to surface. Removing the requirement to pull the BOP stack to surface and redeploy it on the next wellhead.
Boulders	A collection of large rocks, each usually with a diameter of 25.6 cm (10.1 inches) in diameter.
Cambo field	Refers to the UKCS Licensed Block 204/4a, 204/5a, 204/9a, and 204/10a.
Cambo field development	Comprises all project infrastructure proposed to be developed. Includes the Cambo subsea infrastructure, all surface infrastructure at the Cambo field, and the gas export pipeline connecting the Cambo field with the Rosebank GEP.
CAN-ductor	A Conductor Anchor Node suction pile with integrated conductor. The CAN is a combination of suction anchor and guide pipe. The suction anchor pushes the guide pipe into the seabed, providing top support for the conductor.
Carbon budget	Legally binding milestone of anthropogenic CO_2 emissions proposed every 5 years to achieve Net Zero targets.

Carbon Capture Storage	Carbon capture and storage (CCS) is a way of reducing carbon emissions, which could be key to helping to tackle global warming.
Carbon Sinks	Any system, natural or artificial, that absorbs more carbon dioxide (CO_2) from the atmosphere than it releases, thereby reducing the concentration of greenhouse gases in the atmosphere. Natural carbon sinks include forests, soils, and oceans, which capture and store carbon through processes like photosynthesis, carbon sequestration in soil, and oceanic absorption. Artificial carbon sinks or industrial removals involve technologies that capture CO_2 from the atmosphere and store it in underground formations or in other secure locations.
Casing	Steel lining inserted into a well as drilling progresses to prevent the wall of the hole from caving in during drilling, to prevent the inflow of unwanted fluids from surrounding formations and to provide a means of extracting oil (and gas) if a well is productive.
Cephalopods	Class of mollusc characterised by having a prominent head, and a modified mollusc foot in the form of arms or tentacles. Examples include the squid and the octopus.
Cetacean	Aquatic mammals of the order Cetacea, which comprise porpoises, dolphins, and whales.
Circalittoral	The region under shoreline which extends from the lower limit of the shallow waters closest to the shore to the maximum depth at which photosynthesis is still possible.
Cobbles	A collection of rocks varying in diameter from 64 mm to 256 mm (2.5 to 10.1 inches).
Concrete Mattress	A structure made from concrete used to support and protect infrastructure on the seabed.
Conductor	First string of casing to be inserted and cemented into the borehole. Its purpose is to prevent the soft formations near the surface from caving in and to conduct drilling mud from the bottom of the hole to the surface when drilling starts.
Continental shelf	The continental shelf refers to the extension of the continent into the ocean.
Continental slope	The continental slope refers to the sloping margin between the shelf break and the shelf basin.
Contourite	Sedimentary deposit produced by deepwater currents near the bottom of continental slopes. It may be influenced by wind or tidal forces.
Copepods	Small free-living or parasitic crustaceans of the subclass Copepoda, living in marine and fresh waters. The free-living forms are an important constituent of plankton.
Cumulative Impact	Combined impacts arising from different sources which overlap spatially and / or temporally.
Cuttings	Rock chips produced by chipping and crushing action of the drill bit.
Cuttings pile	An accumulation of rock chips or formation debris, produced by the action of the drill bit, and deposited on the seabed.
dB re 1µPa-m	The sound source level measured on the decibel (dB) logarithmic scale at 1 m from the source.
Debris fan	An alluvial (loose, unconsolidated soil or sediment) fan consisting of triangular shaped deposits of sediment transported by an underwater current or glacier.
Deep-sea sponge aggregation	Occurring in waters typically deeper than 250 m, primarily characterised by the presence of structure forming glass sponges or demosponges in high densities.
Demersal	Living in the water column at or near seabed. Usually in relation to fish.
Deterministic Oil Spill Modelling	Oil spill trajectory predictions for actual spills or exercises. Provides single expected forecasts for spills.
Diatoms	Unicellular planktonic algae with silica shells.
Dinoflagellates	Unicellular planktonic organisms often bearing a tough cellulose shell (theca).
Dispersant	A chemical that breaks up concentrations of oil in water, reducing the oil to small droplets (an emulsion).
Diversity	The variety of life forms i.e. distinct organisms within an area.

Downstream	The final stage of the oil and gas industry whereby hydrocarbons are refined and processed intro products such as such as diesel and plastics.
Drill centre manifold	A manifold is a system of headers and branched piping that can be used to gather or distribute fluids, as desired.
Drilling mud/fluid	A mixture of base substance and additives used to lubricate the drill bit and to counteract the natural pressure of the formation.
Dynamic positioning/ dynamically positioned	The stationing of a drilling rig at a specific location in the sea by the use of computer-controlled thrusters.
Echolocation	A technique used by some animals to determine the location of different objects using sound waves.
Elasmobranchs	Subclass of cartilaginous fish species, which includes sharks, rays, skates, guitarfish, and sawfish.
Electrostatic coalescer	A Coalescer is used to separate emulsions into their individual components e.g. water in oil. Electrostatic Coalescers use electrical fields to combine small water droplets.
Emerald Network Conservation Sites	A site considered suitable to achieve the long term survival of the species and habitats of the Bern Convention requiring specific protection measures.
Environmental aspect	An activity that causes an environmental effect.
Environmental baseline survey	Environmental Baseline Study surveys determine the characterization of an area prior the development of a project and establish the initial environmental status.
Environmental effect	A change to the environment or its use.
Environment Identification (ENVID)	The purpose of the Environment Identification (ENVID) process is for the early identification of aspects that can potentially impact the environment.
Environmental Impact	Measurable changes to the baseline environment conditions, as a direct result of project activities.
Environmental Impact Assessment	A tool used to assess the significant effects of a proposed project or development on the environment.
Environmental Statement	An Environmental Statement (ES) is a developer's assessment of the environmental impact of a project.
Epifauna	Benthic organisms that live on the surface of the seabed, either sessile or free moving.
European Protected Species	Species listed in Annex IV of the Habitats Directive.
Extreme weather event	Rare weather phenomenon at a particular place and time of year.
Far-field mixing	The far field relates to the area beyond this initial mixing zone and beyond the influence of the initial discharge momentum; Here plume dispersion is largely dependent on ambient current conditions.
Field	An accumulation of hydrocarbons in the subsurface. Consists of a reservoir in a shape that will trap hydrocarbons and that is covered by an impermeable, sealing rock.
Finfish	A term describing the strictly classified biological group of fishes. Sometimes they are called true fishes to distinguish them from other aquatic life whose common names also end in “fish”, e.g. cuttlefish, or any other aquatic life harvested in fisheries or aquaculture, e.g. shellfish.
Flare	A vent for burning and therefore disposing of unwanted gases or to burn off hydrocarbons when there is no way to transport or utilise them.
Flexible jumpers	Short flexible flowline sections.
Flowline	A pipeline which transports fluids from a wellhead to a manifold or production facility (or vice versa).

Gigatonne (Gt)	A unit of mass, equivalent to 1 billion tonnes or 1 trillion kilograms.
Global Warming Potential	A measure of how much a given mass of gas is estimated to contribute to global warming, relative to the same mass of carbon dioxide.
Greenhouse Gas	Gas that contributes to the greenhouse effect. Includes gases such as carbon dioxide (CO_2) and methane (CH_4). The greenhouse effect results in a rise in temperature due to incoming solar radiation being trapped by carbon dioxide and water vapour in the Earth's atmosphere.
High Case	Reflects the highest anticipated volume of hydrocarbon production (at least P_{10}).
Hydrocarbon	A compound containing only the elements hydrogen and carbon. May exist as a solid, a liquid or a gas. The term is mainly used in a catch-all sense for crude oil, natural gas, condensate and their derivatives.
Iceberg plough mark	Ridges and roughs formed in the seabed through the ploughing movement of icebergs during the last glaciation period.
Ice sheet	An ice body originating on land that covers an area of continental size and that has formed over thousands of years.
Important Bird Areas	A global network of sites for the conservation of birds and bird habitats, set up by BirdLife International.
Immiscible	Fluids that do not mix one another (e.g. oil and water).
Infauna	Animals living within seabed sediments mostly within the top 10 to 15 cm.
Kilotonne (kton)	A unit of mass, equivalent to 1 thousand tonnes or 1 million kilograms.
Loss of well control	An uncontrolled flow of gas, oil or other fluids from the reservoir, i.e. loos of one barrier or leak and loss of two barriers.
Low Case	Reflects the smallest expected volume of hydrocarbon production
Low toxicity oil-based mud	An invert emulsion mud with synthetic oil as the external phase instead of oil.
Macrofauna	Benthic organisms that are retained in a 0.5 mm sieve.
Machair	Fertile low-lying grassy plain found on some north-west coastlines of Ireland and Scotland.
Measured Depth	Depth of the well as measured from the rotary table on the drilling rig, therefore includes the distance between the drilling rig and the seabed
Megafauna	Large or giant animals.
Megatonne (Mt)	A unit of mass, equivalent to 1 million tonnes or 1 billion kilograms.
Meroplankton	The larval stages of fish and benthic invertebrates.
Mid Case	Reflects the best estimated volume of hydrocarbon production
Mobile Offshore Drilling Unit (MODU)	A vessel capable of engaging in drilling or well workover operations for the exploration or exploitation of subsea resources.
Mooring	A permanent structure to which a vessel is secured.
Mud	Fine materials (< 0.063 mm), such as clay and silt.
Mysticetes	Baleen whales, using baleen plates in their mouths to sieve food.
Nature Conservation Marine Protected Area	A type of marine protected area that can be designated in Scottish territorial and offshore waters.
Nautical mile	The near-field zone is the area of strong initial mixing that is sensitive to the discharge design conditions. It is defined as the area within which the discharge reaches the surface or when it achieves vertically stability within the water column.
Near-field mixing	Nautical measurement of distance, equivalent to 1.852 km or 1.15 miles.

Net Zero	Net zero means cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere, by oceans and forests.
Nominal Bore	Approximate measure of the hollow section of a pipe.
North Sea Transition Deal	A plan for how the UK's offshore oil and gas sector and the government will work together to meet greenhouse gas emissions reduction targets.
Nursing	Period of development of fish juveniles.
Offshore Petroleum Regulator for Environment and Decommissioning (OPRED)	OPRED is responsible for regulating environmental and decommissioning activity for offshore oil and gas operations, including carbon capture and storage operations, on the UK continental shelf.
Ocean quahog	A long-lived species of clam which lives buried in sediments.
Oil based mud	Drilling mud with oil as the fluid continuous phase.
Odontocetes	Toothed whales (including dolphins and porpoises).
Ozone	Atmospheric gas which acts as a pollutant creating smog at ground level, and in the upper atmosphere filters out ultra-violet light from reaching the earth.
Pelagic	Inhabiting the water column of the sea.
Permanent Threshold Shift	As sound exposure increases this is the level at which the threshold shift will be permanent.
Phytoplankton	Free floating microscopic plants.
Pig	A pipeline inspection gauge, commonly referred to as a pig, is a device used to clean and inspect a pipeline.
Piling	The process of driving or boring pile foundations into the seabed.
Pinniped	Aquatic mammals composed of seals, sea lions, and walrus.
Pipeline End Termination	A connection point between the pipeline and a subsea structure or another pipeline.
Plankton	Free floating organisms found in the oceans and other aquatic systems.
Polychaete	A class of marine annelid worms.
Priority Marine Feature	Priority Marine Features (PMFs) are species or habitats which the national conservation bodies responsible for Scottish waters (NatureScot and Joint Nature Conservation Committee (JNCC)) consider to be marine nature conservation priorities. The aim of the PMFs work is to produce a focused list of marine habitats and species to help target future conservation work in Scotland.
Propagation (underwater sound)	Movement of sound through the water.
Ramsar sites	Wetlands of international importance.
Reef	A collection of rocks, corals or ridge of sand just above or below the surface of the sea.
Representative Concentration Pathways	Representative Concentration Pathways or RCP values are scenarios for the future that project greenhouse gas concentrations and their resulting impact on the climate, expressed in watts per square metre (w/m^2). RCPs were used in the previous IPCC assessment reports and are analogous to the 'y' values used in the SSPx-y scenarios used in the IPCC's most recent 6^{th} assessment report (AR6).
Reservoir	The underground formation where oil and gas has accumulated. It consists of a porous rock to hold the oil or gas, and a cap rock that prevents its escape.
Riser	A vertical pipe which connects a subsea wellhead or pipeline to an offshore installation (e.g a MODU or FPSO) during drilling or production operations.

Sand	Fine debris of rocks, consisting of small, loose grains. Very find sand has a diameter of no less than 0.063 mm, and very course sand has a diameter of no more than 2.0 mm.
Scope 1 Emissions	Greenhouse gas emissions categorised as Scope 1 emissions are those that a company makes directly such as fuel use when operating vehicles or vessels.
Scope 2 Emissions	Greenhouse gas emissions categorised as Scope 2 emissions are those that a company makes indirectly such as the purchase of energy for heating buildings.
Scope 3 Emissions	Greenhouse gas emissions which include all other indirect emissions that occur in the upstream and downstream activities of an organisation.
Seabed take	A reduction in the total extent of the original seabed habitat (take) resulting from development infrastructure on the seabed.
Separator	A pressure vessel used for separating gas and liquid components from processed fluids.
Site of Community Importance	A site which contributes significantly to the maintenance or restoration at a favourable conservation status of a natural habitat type in Annex I or of a species in Annex II under the EU Habitats Directive.
Site of Special Scientific Interest	An area of land and water considered to best represent Scotland's natural heritage in terms of flora, fauna, geology, and geomorphology. Designated under the Nature Conservation (Scotland) Act 2004 by NatureScot.
Skirted Mud Mat Foundation	A shallow foundation in which the structure loads are transferred to deeper soil layers by vertical slender elements (skirts) that confine the soil beneath the foundation footprint.
Soft Start	Gradual, or incremental, increase in hammer blow energy / frequency.
Sound Exposure Level	A metric that is used to quantify underwater sound.
Source-Pathway-Receptor (SPR) analysis	For the identification of the impact and consequential effects. 'source' describes the origin of the impact. 'pathway' is the means by which the source reaches the affected 'receptor'.
Spawning	The production and release of gametes (eggs or sperm) by animals.
Special Area of Conservation	Protected sites designated under the EU Habitats Directive in order to conserve important habitats and species (excluding birds).
Special Protection Area	Sites designated by the UK Government under the EC Birds Directive to protect certain rare, vulnerable, and regularly occurring migratory species of birds.
Spool	Short segment of rigid pipe with a flange or other connecting fitting at either end and is commonly used to connect flowlines and / or subsea facilities together, e.g. a subsea tree to a subsea manifold.
Spreading Loss	The geometric weakening of a sound signal as it spreads outwards from a source.
Standard cubic metre	Measurement of the amount of gas at a predetermined reference pressure and temperature, usually 101.325 kPa (1 atmosphere) pressure and 15.6℃ (60℉).
Stochastic Oil Spill Modelling	Modelling based on actual statistical wind speed and direction frequency data. Provides a probability range of sea surface oil and beaching, representative of the prevailing conditions.
Subsea Isolation Valve (SSIV)	Valve generally used in a manifold that closes or isolates a particular pipeline or process in the event of an emergency.
Suction Foundation	A foundation pile or anchor inserted into the seabed and held in place by suction.
Temporary Threshold Shift	Threshold shifts that recover to baseline levels relatively soon following exposure, in hours, days or weeks.
Transboundary Impacts	Potential environmental impacts on the seabed, water column and/or atmosphere, which extend beyond the boundaries of the United Kingdom Continental Shelf.
Trenching	The practice of constructing trenches in or adjacent to a pit for the purpose of relocating all or a portion of the solids so as to facilitate closure.

Umbilical	Connections used between the subsea equipment and/or surface installation (e.g. FPSO) and enabling the provision of control, power, communications and chemical services from the surface.
Umbilical Termination Assembly	Provides the hydraulic, chemical, fibre optic and electrical distribution between the control umbilical and the subsea system.
Underwater Sound Attenuation	As sound spreads underwater, it decreases in strength with distance from the source. This transmission loss is the sum of spreading loss and attenuation loss. Spreading loss is the geometric weakening of a sound signal as it spreads outwards from a source. Attenuation losses are the physical processes in the sea that distort the mathematical spreading laws.
United Kingdom Biodiversity Action Plan (UK BAP)	The UK BAP describes the biological resources of the UK and provides detailed plans for conservation of these resources
Upstream	The initial phase in the oil and gas industry comprising exploration for and drilling and extraction of hydrocarbons.
Venting	The discharge of un-burnt, unwanted gases or hydrocarbons.
Water based mud	A type of drilling fluid (mud) consisting mainly of water, which has additives to modify it and make it more effective.
Wellhead	The unit at the surface of a well which controls pressure and connects to drilling and production equipment. The wellhead is the upper part of the well, located above the casing and under the drilling floor.
Well problem	Accidental problem with the well, i.e. loss of one barrier or other downhole problems, whilst control of the well is maintained.
Wildlife Disturbance Licence	It is an offence to deliberately disturb European Protected Species therefore an assessment may be required as to whether proposed activities may cause an offence.
Workover	The process of performing maintenance or remedial treatments on an oil or gas well.
Xmas Tree	Assembly of valves and fittings to control the flow of oil and gas from the target reservoir.
Zooplankton	Animals which drift in the water column along with prevailing currents, mostly microscopic.

Abbreviations

AHV	Anchor Handling Vessel
AFEN	Atlantic Frontier Environmental Network
AICD	Autonomous Inflow Control Device
AIS	Automatic Identification System
Al	Aluminium
ALARP	As Low As Reasonably Practicable
AONB	Areas Of Outstanding Natural Beauty
AoO	Advice On Operations
API	American Petroleum Institute
AP OHGP	Alternate Path Open Hole Gravel Pack
AR	Assessment Report
As	Arsenic
ASCOBANS	Agreement On The Conservation Of Small Cetaceans Of The Baltic And North Seas
AUD INJ	Auditory Injury
AUV	Autonomous Underwater Vehicle
Ba	Barium
BAT	Best Available Technique
bbls	Barrels
BEIS	Department Of Business, Energy And Industrial Strategy
BEP	Best Environmental Practice
BERR	Department For Business, Enterprise And Regulatory Reform
BGS	British Geological Survey
BHGE	Baker Hughes General Electric
BOP	Blowout Preventer
BTEX	Benzene, Toluene, Ethylbenzene And Xylene
BWM	Ballast Water Management
CAN-ductor	Conductor Anchor Nodes
CapEx	Capital Expenditure
CCC	Climate Change Committee
CCS	Carbon Capture And Storage
CCUS	Carbon Capture, Usage, and Storage
Cd	Cadmium
CDP	Carbon Disclosure Project
CEFAS	Centre For Environment, Fisheries And Aquaculture Science
CEMP	Coordinated Environmental Monitoring Programme
CES	Crown Estate Scotland

CFU	Compact Flotation Unit
CH_4	Methane
CHARM	Chemical Hazard Assessment And Risk Management
CM	Central Meridian
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COP21	Un Climate Change Conference
COT	Cargo Oil Tank
CPI	Carbon Preference Index
CP-SAT	Chemical Permit-Subsidiary Application Template
Cr	Chromium
CSV	Construction Support Vessel
CTD	Conductivity, Temperature, Depth
CtL	Consent To Locate
Cu	Copper
Cuin	Cubic Inches
DC	Drill Centre
DEA	Drag Embedment Anchors
DECC	Department Of Energy And Climate Change
Defra	Department For Environment, Food And Rural Affairs
DepCon	Deposit Consent
DESNZ	Department Of Energy Security And Net Zero
DLE	Dry Low No_x Emissions
DNA	Deoxyribonucleic Acid
DP	Dynamically Positioned / Dynamic Positioning
DPM	Diesel Particulate Matter
DRA	Drilling Operations Application
DTI	Department Of Trade And Industry
EBS	Environmental Baseline Survey
EC	European Commission
ECMWF	European Centre For Medium-Range Weather Forecasts
EEA	European Environmental Agency
EEMS	Environmental And Emissions Monitoring System
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation And Data Network
EMP	Environmental Management Plan
EMS	Environmental Management System

ENG	England
ENVID	Environmental Issues Identification
EOR	Enhanced Oil Recovery
E_p	Sound Exposure
EPS	European Protected Species
EPS	Early Production System (Section 3 Only)
ERAP	Emissions Reduction Action Plans
ERL	Effect Range Low
ERRV	Emergency Response And Rescue Vessel
ES	Environmental Statement
ESOS	Energy Savings Opportunity Scheme
ESP	Electrical Submersible Pump
ETS	Emissions Trading Scheme
EU	European Union
EUNIS	European Nature Information System
FARICE	Faroe Iceland Communication Cable
FDP	Field Development Plan
Fe	Iron
FeAST	Feature Activity Sensitivity Tool
FEED	Front End Engineering And Design
FEL	Fish Eggs And Larvae
F&F	Fuel & Flare
FEPA	Food And Environment Protection Act
FHG	Functional Hearing Group
FLAGS	Far North Liquids And Associated Gas System
FNSB	Fish with no swim bladder
FOC	Fibre Optic Cable
FPSO	Floating Production Storage And Offloading
FRG	Free Radical Generator
FSBP	Fish with swim bladder in which hearing involves the swim bladder
FSBV	Fish with swim bladder in which hearing does not involve the swim bladder
FSU	Floating Storage Unit
GEP	Gas Export Pipeline
GES	Good Environmental Status
GFU	Gas Flotation Unit
GGR	Greenhouse Gas Removal
GHG	Greenhouse Gas
GIS	Geographic Information System

GOR	Gas To Oil Ratio
Gt	Gigatonne
GTG	Gas Turbine Generator
GWP	Global Warming Potential
H_2S	Hydrogen Sulphide
HA	Habitat Assessment
HF	High Frequency (Cetacean)
Hg	Mercury
HIPPS	High Integrity Pressure Protection System
HLV	Heavy Lift Vessel
HMCS	Harmonised Mandatory Control System
HOCNS	Harmonised Offshore Chemical Notification System
HP	High Pressure
HRA	Habitat Regulations Appraisal
HSE	Health, Safety and Environmental
HSE	Health And Safety Executive (References Section Only)
HVDC	High-Voltage, Direct Current
HVO	Hydrotreated Vegetable Oil
IBA	Important Bird Areas
ICES	International Council for The Exploration of The Sea
IEMA	Institute Of Environmental Management and Assessment
IG	Inert Gas
ILT	In Line Tee
IMO	International Maritime Organization
IOGP	International Association of Oil and Gas Producers
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
IPPC	Integrated Pollution Prevention and Control
ISGP	Ithaca Energy Stage Gate Process
ISO	International Standards Organisation
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
JV	Joint Venture
KO	Knock-Out
KPI	Key Performance Indicators
kton	Kilotonne
LAT	Lowest Astronomical Tide

LDI	Lean Direct Injection
L_E	Cumulative Sound Exposure Level
LF	Low Frequency (Cetacean)
LP	Low Pressure
LTOBM	Low Toxicity Oil Based Mud
LULUCF	Land Use, Land-Use Change and Forestry
MA	Major Accidents
MFA	Uk Mutual Aid Framework Agreement
MAH	Major Accident Hazard
MARPOL	International Convention for the Prevention of Pollution From Ships
MAT	Master Application Template
MCAA	Marine And Coastal Access Act
MEG	Monoethylene Glycol
MEI	Major Environmental Incident
MER	Maximising Economic Recovery
MINNS	Marine Invasive Non-Native Species
MITgcm	Massachusetts Institute Of Technology General Circulation Model
MMO	Marine Mammal Observation
MMscf	Million Standard Cubic Feet
Mn	Managanese
MoD	Ministry Of Defence
MODU	Mobile Offshore Drilling Unit
MPA	Marine Protected Area
MPPE	Macro Porous Polymer Extraction
MSFD	Marine Strategy Framework Directive
Mt	Megatonne
N_2O	Nitrous Oxide
NAMMCO	North Atlantic Marine Mammal Commission
NASS	North Atlantic Sightings Survey
NB	Nominal Bore
NCMPA	Nature Conservation Marine Protected Areas
NDC	Nationally Determined Contributions
Ni	Nickel
NI	Northern Ireland
nm	Nautical Mile
NMFS	National Marine Fisheries Service
NMHC	Non-Methane Hydrocarbons
NMP	National Marine Plan

NMPi	National Marine Plan Interactive
NOAA	National Oceanic And Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NOx	Nitrogen Oxides
NPD	Naphthalene, Phenanthrene/Anthracene And Dibenzothiophene
NPI OPEP	Non Production Installation Oil Pollution Emergency Plan
NRC	National Research Council
NSTA	North Sea Transition Authority
NSTD	North Sea Transition Deal
NSTF	North Sea Task Force
NTS	Non-Technical Summary
OBM	Oil Based Mud
OCNS	Offshore Chemical Notifications Scheme
OCR	Offshore Chemical Regulations 2002 (As Amended)
OEUK	Offshore Energies United Kingdom
OGA	Oil And Gas Authority
OGMP	Oil And Gas Methane Partnership
OGUK	Oil And Gas UK
OIM	Offshore Installation Manager
OIW	Oil In Water
OLP	Oil Discharge Permit (Life) Sat
OMR	Offshore Marine Regulations
OOZI	Out Of Zone Injection
OPEP	Oil Pollution Emergency Plan
OPEX	Operational Expenditure
OPF	Organic-Phase Drilling Fluids
OPOL	Offshore Pollution Liability Association Limited
OPPC	Oil Pollution Prevention And Control
OPRED	Offshore Petroleum Regulator For Environment And Decommissioning
OSCAR	Oil Spill Contingency And Response
OSD	Offshore Safety Directive
OSPAR	Oslo And Paris Convention
OSPRAG	Oil Spill Prevention And Response Advisory Group
OSRL	Oil Spill Response Limited
$p_{0\text{-}pk}$	Peak Sound Pressure
Pa	Pascals
PAH	Polycyclic Aromatic Hydrocarbons
PAME	Protection Of The Arctic Marine Environment

PM	Particulate Matter
Pb	Lead
PDCA	Plan-Do-Check-Act
PEC	Predicted Environmental Concentration
PETS	Portal Environmental Tracking System
PEXA	Practice And Exercise Area
PIC	Pressure Indicator Controller
PL	Propagation Loss
PLA	Pipeline Operations Mat
PLEM	Pipeline End Manifold
PLET	Pipeline End Termination
PLONOR	Pose Little Or No Risk To The Environment
PL(r,f)	Propagation Loss Curves
PM	Particulate Matter
PMF	Priority Marine Feature
PMI	Potential Mortal Injury
PNEC	Predicted No Effect Concentration
POBM	Pseudo-Oil Based Muds
POOH	Pull-Out-Of-Hole
PPD	Pour Point Depressant
p_{pk}	Peak Sound Pressure
Pr	Pristane
PRA	Production Operations Mat
p_{rms}	Sound Pressure
PSD	Particle Size Distribution
p(t)	Instantaneous Sound Pressure
PTS	Permanent Threshold Shift
PW	Produced Water
PW	Pinnipeds/Phocids In Water (Section 12 only)
PWA	Pipeline Works Authorisation
PWRI	Produced Water Re-Injection
PWTP	Produced Water Treatment Package
RBA	Risk-Based Approach
RI	Recoverable Injury
RL	Received Level
RLV	Reel Lay Vessel
RMS	Root-Mean Square
RO	Reverse Osmosis

ROV	Remotely Operated Vehicle
RSD	Relative Standard Deviation
RSPB	Royal Society For The Protection Of Birds
SAC	Special Area Of Conservation
SAS	Standalone Screen
SAT	Subsidiary Application Template
SBM	Synthetic-Based Mud
SCANS	Small Cetaceans In European Atlantic Waters And The North Sea
SCO	Scotland
SCOS	Special Committee On Seals
SECR	Streamlined Energy And Carbon Reporting
Se	Selenium
SEL	Sound Exposure Level (See Also SL_E)
$SEL_{24h,w}$	24-Hour Weighted Cumulative Sound Exposure Level
SEL(r)	Unweighted Sound Exposure Level
SEL_{ss}	Single-Strike Sound Exposure Level
SEL_T	Unweighted Cumulative Sound Exposure Level
SEMS	Safety And Environmental Management System
SDC	Subsea Distribution Centre
SFF	Scottish Fishermen's Federation
SIRGE	Shetland Island Regional Gas Export System
SL	Source Level
SL(f)	Source Level Spectrum
SL_E	Sound Exposure Level
SL_{pk}	Peak Sound Pressure Level
SL_{rms}	Sound Pressure Level
Sm^3	Standard Cubic Metre (Also See Glossary)
Sn	Tin
SNH	Scottish Natural Heritage
SoS	Secretary Of State
SOSI	Seabird Oil Sensitivity Index
SOTEAG	Shetland Oil Terminal Environmental Advisory Group
SPA	Special Protection Areas
SPAR	Single Point Anchor Reservoir
SPE	Siccar Point Energy
SPL	Sound Pressure Level
$SPL_{0\text{-}pk}$	Peak Sound Pressure Level (See Also Sl_{pk})
SPL_{pk}	Peak Sound Pressure Level

$SPL_{pk,flat}$	Unweighted Peak Sound Pressure Level
SPL_{rms}	Sound Pressure Level (See Also SI_{rms})
SPR	Source-Pathway-Receptor
SPS	Subsea Production System
Sr	Strontium
SRB	Sulphate Reducing Bacteria
SRU	Sulphate Removal Unit
SSP	Shared Socio Economic Pathways
SSS	Side Scan Sonar
SSSI	Sites Of Special Scientific Interest
STP	Submerged Turret Production
STV	Sullom Voe Terminal
SURF	Subsea Umbilicals, Risers, And Flowlines
SW	Seawater
T&D	Transmission And Distribution
TCFD	Task Force On Climate-Related Financial Disclosures
TEG	Triethylene Glycol
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
THC	Total Hydrocarbon Content
TIC	Temperature Indicator Controller
TLP	Tension-Leg Platform
TLW	Tonnes Per Live Weight
TOM	Total Organic Matter
TOOPEP	Temporary Operations Oil Pollution Emergency Plan
TTS	Temporary Threshold Shift
TVDSS	True Vertical Depth Sub-Surface
UCM	Unresolved Complex Mixture
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention On Climate Change
UK	United Kingdom
UKBAP	United Kingdom Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
UKOOA	United Kingdom Offshore Operators Association
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
V	Vanadium
VFA	Volatile Fatty Acids

VHF	Very High Frequency (Cetacean)
VIEC	Vessel Internal Electrostatic Coalescer
VOC	Volatile Organic Compound
VRU	Vapour Recovery Unit
VSP	Vertical Seismic Profiling
VTS	Vessel Traffic Survey
WAL	Wales
WBM	Water Based Mud
W(f)	Weighting Function
WHRU	Waste Heat Recovery Units
WI	Water Injection
WIM	Water Injection Manifold
WiO	Water in Oil
WMO	World Meteorological Organization
WMP	Waste Management Plan
WONS	Well Operations Notification System
WOR5	World Ocean Review 5
WoSE	West Of Shetland Electrification
WOSPS	West Of Shetland Pipeline System
Zn	Zinc
ZRF	Zero Routine Flaring

Non-Technical Summary

This Non-Technical Summary provides an overview of the Environmental Statement prepared for the Cambo field development proposed by Ithaca SP E&P Limited, an affiliate of Ithaca Energy (UK) Limited (Ithaca Energy (UK) Limited and its affiliated companies being referred to throughout this Environmental Statement as 'Ithaca Energy'). The purpose of the Environmental Statement is to report the results of the Environmental Impact Assessment that has been undertaken by Ithaca Energy to identify any likely significant effects on the environment from the proposed development. The Environmental Statement has been prepared in accordance with the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 and associated guidelines.

The proposed Cambo field development is located in United Kingdom Continental Shelf (UKCS) Blocks 204/4a, 204/5a, 204/5b, 204/9a, 204/10a, 205/1b and 205/2b, in the West of Shetland region. The Cambo field is approximately 133 km west of the Shetland Islands and 8 km east of the UK / Faroes transboundary line. The proposed development comprises three subsea drill centres with nine production wells in total, four water injection wells and a gas export pipeline. The wells will be tied back to a Floating Production, Storage and Offloading (FPSO) vessel, operated by Ithaca Energy. The proposed gas export pipeline would tie into the Rosebank Gas Export Pipeline (subject to commercial negotiations), located northeast of the Cambo field, which is connected to the West of Shetland Pipeline System.

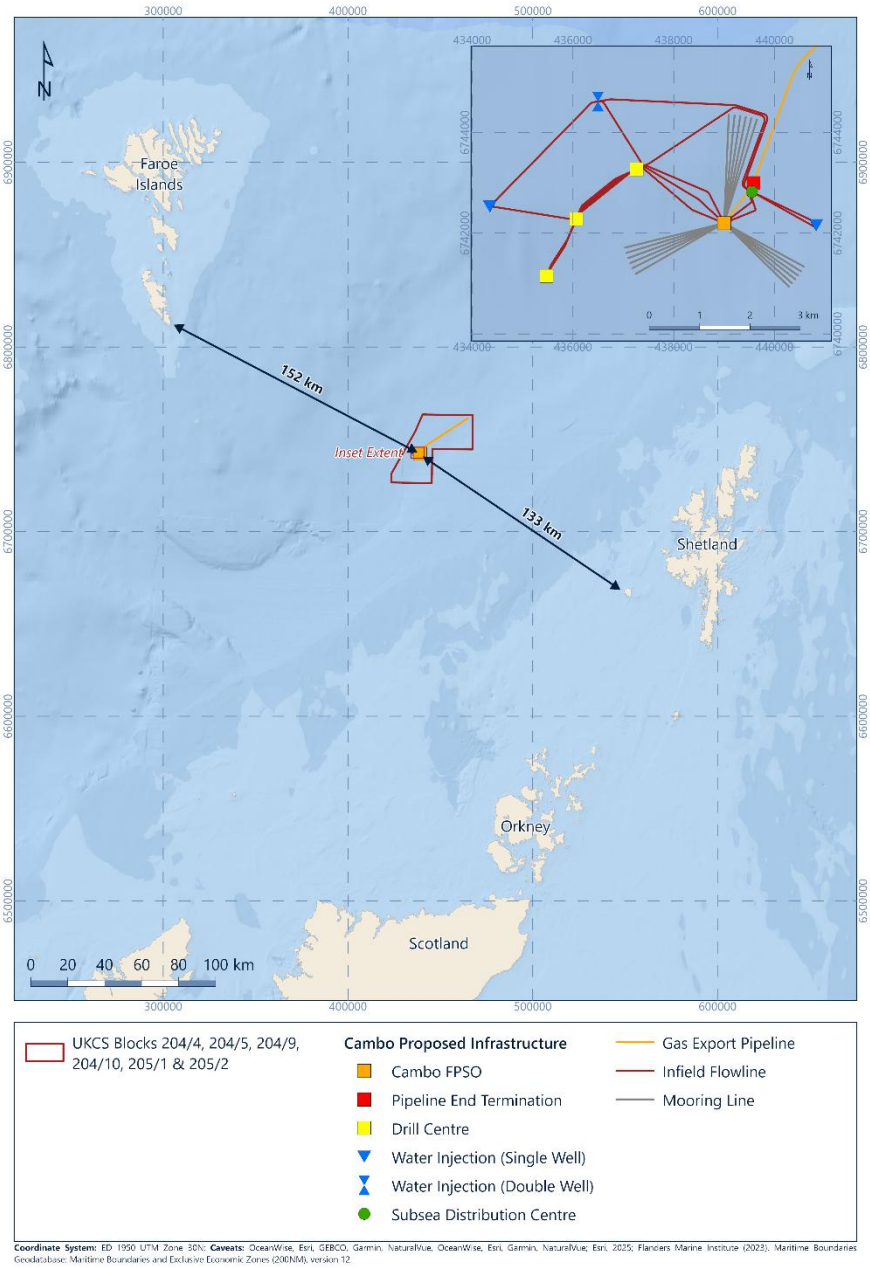


Figure 1: Location of the proposed Cambo field development

The Environmental Assessment Process and Environmental Management

Offshore oil and gas activities can involve a number of environmental interactions and impacts due, for example, to operational emissions and discharges and general disturbance. The objective of the Environmental Impact Assessment process is to incorporate environmental considerations into the project planning and design activities, to ensure that best environmental practice is followed and ultimately to achieve a high standard of environmental performance. The process also provides for the potential concerns of stakeholders to be identified and addressed, as far as possible, at an early stage. In addition, it ensures that the planned activities are compliant with legislative requirements and Ithaca Energy's own management procedures.

All project activities are carried out in accordance with Ithaca Energy's Health, Safety, and Environmental Policy. This Policy forms part of the company's overall Management System and aligns wider regulatory

compliance with its own policies, standards and ways of working, in order to achieve good care of the environment. The environmental performance of any third parties contracted to support Ithaca Energy activities will be controlled under the auspices of this Policy.

Ithaca Energy reviews the impact all activities may have on the environment and ensures that all environmental risks are adequately identified, controlled or mitigated to an acceptable level by way of formal assessment.

Ithaca SP E&P Limited is appointed as Well Operator for Cambo. An application to appoint an Installation Operator will be made at a later date.

All operational activities undertaken on behalf of Ithaca Energy will be managed under the appointed Installation/Well Operator's Environmental Management System. Third parties will need to demonstrate to Ithaca Energy that an Environmental Management System certified (and verified by an external verification company) to the International Standard for Environmental Management Systems, ISO 14001:2015, is in place and implemented.

Specific environmental management activities relating to operational activities will be taken forward in an Environmental Management Plan which will incorporate the mitigation, control and monitoring measures identified in this environmental statement as well as the responsibilities for implementation.

Net Zero Action Plan

The UK has a legally binding target to reduce greenhouse gas emissions to Net Zero by 2050. Whilst continued exploration and production on the UKCS is supported these activities must be undertaken in a manner that ensures compliance with this target Net Zero targets for the industry including the reduction, as far as reasonable, of greenhouse gas emissions from sources such as flaring, venting and power generation.

Ithaca Energy recognises that the sector has a role to play, in conjunction with key stakeholders such as government and regulatory authorities, to reduce the impacts of climate change from carbon related emissions. To date, Ithaca Energy has been able to reduce methane emissions and emissions intensity from its portfolio and remains on track to meet the North Sea Transition Deal reduction targets. Further opportunities to improve efficiencies and decarbonise operations are already underway including electrification of assets, flare gas recovery and upgrades to power generators to reduce diesel consumption.

Ithaca Energy continues to liaise with the NSTA and operators at Ithaca Energy non-operated assets regarding future decarbonisation opportunities both at the Cambo field and across Ithaca Energy's portfolio of assets.

The Proposed Operations

The proposed Cambo field development comprises a FPSO vessel, three subsea drill centres with nine production wells in total, four water injection wells and a gas export pipeline. An optional appraisal well may also be drilled as part of the Cambo field development to confirm the optimal location for the third drill centre. The wells will be drilled using a Mobile Offshore Drilling Unit (MODU). The MODU to be

used to drill the Cambo wells is not yet confirmed but will be either a semi-submersible drilling unit or a drillship designed to operate in deepwater harsh environments.

Hydrocarbons will be produced from the three drill centres into the FPSO. Onboard the FPSO the produced oil and gas will be separated and the oil stored onboard the FPSO for offloading via shuttle tankers which will periodically visit the field to take off the oil. The produced gas will be used to power the FPSO, with the remainder of the gas being exported via a 32.5 km pipeline which ties into the Rosebank Gas Export Pipeline, located northeast of the Cambo field, which is connected to the West of Shetland Pipeline System (Figure 2).

Once the Cambo reservoir starts producing water along with the oil and gas, this water will be separated out and cleaned-up to contain less than 15 mg/l of oil (on a monthly average basis), before being discharged overboard.

Ithaca Energy is currently planning to commence offshore development activities at the Cambo field in Q2 2028, with drilling operations beginning in Q3 2028. First oil is expected in Q4 2030. At present, it is anticipated that the Cambo field development will produce hydrocarbons until 2055.

Option Selection

Developing the Cambo field will support the objectives of the UK's current energy policy, as set out in the Oil and Gas Authority (OGA) Strategy (now administered by the North Sea Transition Authority (NSTA)), which replaced the earlier Maximising Economic Recovery UK Strategy. The updated OGA Strategy retains the focus on maximising the economic recovery of petroleum while integrating obligations to reduce GHG emissions as far as reasonably possible including taking reasonable steps to limit emissions from flaring, venting, and power generation, and support carbon capture and storage initiatives.

Whilst not developing the Cambo field would avoid any potential for environmental impact, it would prevent the production of oil and natural gas from the Cambo field that would help to meet the UK's energy needs and no economic benefit would be realised.

Various options for the field development were evaluated in terms of technical feasibility, environmental impact, health and safety, reputation and cost. The environmental assessment process was initiated early in the planning stage to support the option selection process, and actively drive mitigation measures, where certain impacts could not be avoided.

A detailed option selection process has been conducted throughout the Cambo project, and the main considerations relating to environmental impacts are summarised below.

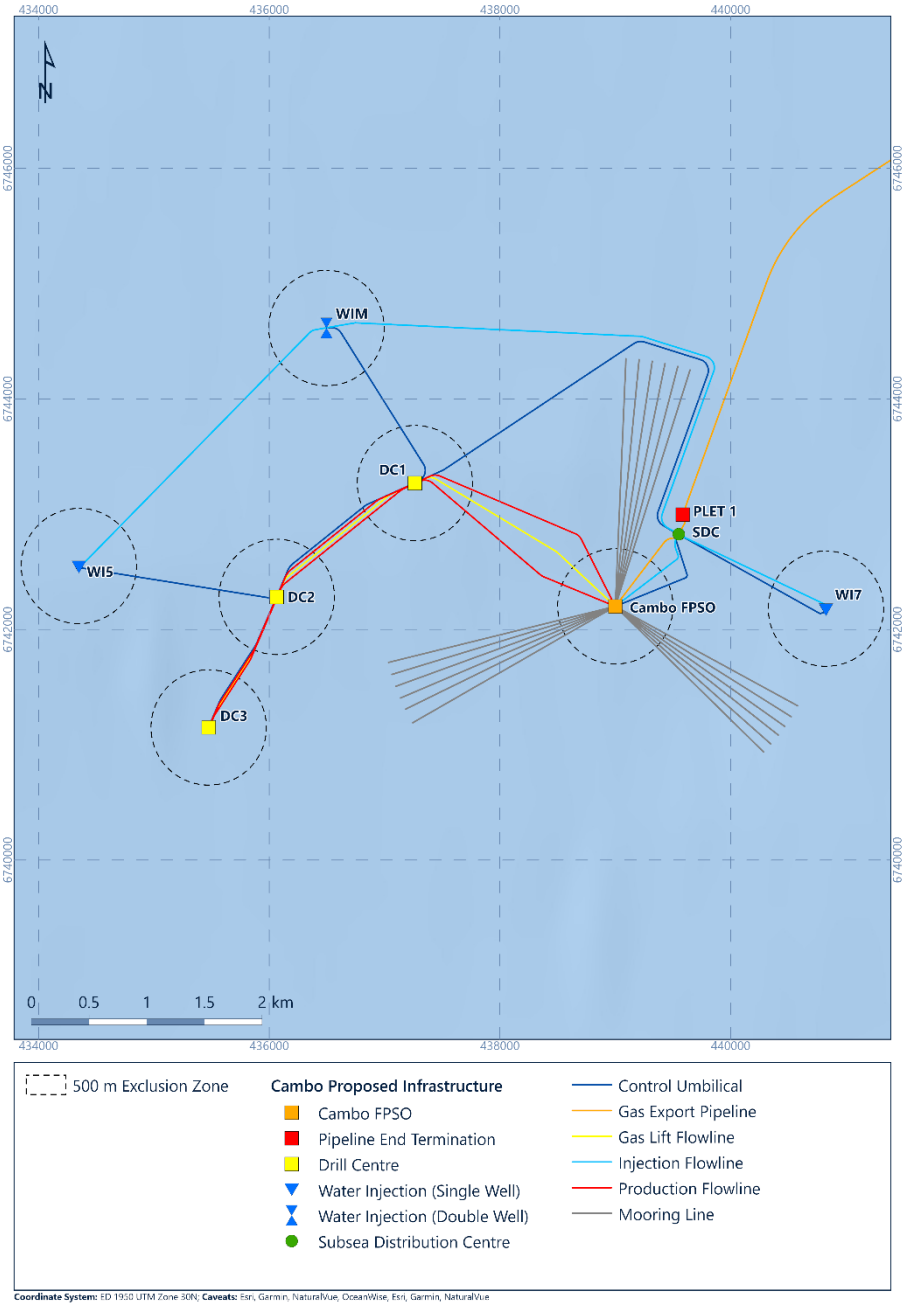


Figure 2: Proposed Cambo field development infrastructure

Field Development Concept

A number of potential concepts for field development have been considered for the Cambo project, including:

- Early Production System;
- Full Field Standalone Development;
- Hub Development;
- Full Stream Tie-Back;
- Long Range Tie-Back to Shallow Water Platform; and
- Phased Development.

Due to the water depth at Cambo (between 1,073 m and 1,105 m), the areal extent of the field and the low well density and shallow nature of the Cambo reservoir, all concepts were centred on a wet subsea production system with surface processing facilities. The conclusions from the evaluation showed that while all options were technically feasible, a full field development on a standalone basis was preferred based on the following key decision criteria:

- Improved confidence/understanding of the Cambo reservoir, deliverability and recoverable resources through the successful drilling and test of the Cambo 204/10a-5Y well;
- More substantive incorporation of features to reduce environmental impact; and
- Increased confidence in the Cambo reservoir supporting a full field development from the outset.

This set out the base case for the remainder of the option selection process.

Drilling and Well Design

The proposed Cambo host facility will not have any drilling capability and therefore a MODU will be required to drill the wells. Due to the water depth, floating MODUs are considered the only feasible option. A dynamically positioned floating MODU (as opposed to one utilising an anchor mooring system) can be positioned more readily between the various drilling locations at the field and reduces the potential environmental impacts from anchors. The nature of the drilling programme is such that MODU moves will be frequent. Two MODU types considered were a semi-submersible drilling rig or a drill ship.

The key criteria considered when reviewing the type of MODU to use included:

- Deepwater capability;
- Favourable motion characteristics under harsh weather conditions West of Shetland and likely weather uptime; and
- Operational efficiency in subsea completions.

A review of the two options noted that drill ships offer favourable mobility, transit speed and deck load capacity whilst the semi-submersible hull design possess greater stability / improved vessel motion response to Cambo field metocean conditions, resulting in higher uptime / reduced risk of frequent disconnection. It was concluded that both MODU types would be suitable for use in the Cambo field development.

Two options were identified for drilling fluids:

1. Water Based Mud with cuttings disposal to sea; and
2. Low Toxicity Oil Based Mud which would be
    a. skipped and shipped to shore; or
    b. thermally treated offshore and discharged to sea.

WBM will be used to drill the upper well sections, as is standard practice. Previous drilling campaigns at Cambo have successfully used WBM for the lower well sections and therefore will also be considered for the planned Cambo wells. All cuttings and spent WBM would be discharged to sea. However, the option to use low toxicity oil-based mud will be retained for the lower well sections due to the improved operating performance in drilling operations over WBM under certain circumstances. If used, any low toxicity oil-based mud contaminated cuttings will either be contained on the MODU and shipped to shore for treatment or thermally treated offshore before being disposed to sea.

Reservoir Management

Four options were considered for the depletion strategy for the Cambo field development:

1. Natural depletion;
2. Water injection;
3. Gas injection; and
4. Enhanced oil recovery.

Based on the goal of maximizing economic oil recovery, water injection was selected as the preferred depletion strategy.

Produced Water Management

Produced water comprises Cambo formation water plus gradually increasing quantities of injection water over the life of field. A range of options were considered for the management of the production and disposal of produced water, summarised as follows:

- Minimisation of produced water production during operations;
- Produced Water Reinjection to producing formations;
- Produced water injection into a non-producing formation via disposal well(s); and
- Treatment (clean up) and overboard discharge to sea.

Of these, two options for produced water management were taken forward for further assessment for the Cambo field development; produced water reinjection into the Cambo producing formation and produced water disposal to sea. Both options were assessed, applying the principles of best available technology / best environmental practice and considering technical viability and risk. Based on the assessment, Ithaca Energy selected produced water treatment (clean-up) and discharge to sea for the development based on the following main factors:

1. Reservoir Souring; and
2. Reservoir Injectivity.

Given its relative low temperature, the Cambo reservoir conditions are favourable to Sulphate Reducing Bacteria activity. The reservoir fluids, whilst initially 'sweet', are expected to 'sour' with Hydrogen Sulphide generation resulting from water injection activity. This would be significantly exacerbated by injecting produced water back into the reservoir, and hence the selected option is to clean the produced water to less than 15 mg/l oil content (the OSPAR limit is 30mg/l) and discharge it sea.

The Cambo reservoir is characterised by relatively weak, unconsolidated rock. As a consequence, downhole sand control and stringent adherence to water injection specifications are required to maintain injectivity and reduce the risk of out of zone injection. Therefore, in order to maintain injectivity and hence pressure support, it is preferred to inject filtered and treated seawater to reduce otherwise likely permeability impairment and poor operability of produced water re-injection systems (by sand/fines and/or residual oil in injected produced water).

To reduce the potential for Hydrogen Sulphide production in the reservoir any seawater must be treated before being injected into the wells. The three options considered were:

1. Continuous biocide injection;
2. Low sulphate seawater injection; and
3. Nitrate injection.

Due to the reservoir characteristics, neither continuous biocide injection nor nitrate injection were considered technically viable. Continuous biocide injection is not a proven technology in a sandstone reservoir such as that found in the Cambo field and nitrate injection was rejected as it was not proven technology at the low Cambo reservoir temperatures. Low sulphate seawater injection was therefore selected as the souring control measure.

Host Facilities

Due to the water depth at the Cambo field development, host options focussed on permanently-moored floating systems. Fixed structures (e.g. compliant tower or similar) at the Cambo field location were discounted given the water depth and environmental conditions in the area. To date no such platforms have been deployed at these water depths and in comparable metocean conditions. Non-permanently moored floating options e.g. units operating with dynamic positioning were also ruled out for safety and reliability reasons.

Several floating concepts were considered for the proposed field development:

- A semi-submersible platform;
- A Floating Production Storage and Offloading (FPSO) vessel;
- Single Point Anchor Reservoir (SPAR) platform; and
- A Tension Leg Platform.

Each concept was examined to determine its suitability for the field development.

A FPSO vessel was selected on the basis that this is a well-proven concept already delivered into the West of Shetland area on the UKCS.

The large areal extent and relatively shallow depth of the Cambo reservoir is such that it is not possible to fully develop the field from a single drill centre. When considering which subsea system to deploy at the Cambo field, Ithaca Energy considered three principle options:

1. Individual well tie-backs to the host facilities;
2. Close-clustered wells and subsea manifolds; and
3. Subsea templates.

A subsea manifold (at each drill centre) is a structure consisting of pipework and valves designed to transfer oil and gas from individual well into a pipeline or flowline. A subsea template is a larger, heavier steel structure which is used as a base for various subsea structures such as wells, subsea trees and manifolds. All options were considered to be viable for the proposed field development. However, close-clustered wells and subsea manifolds, was selected on the following basis:

- Clustered wells/subsea manifolds are well suited to a field like Cambo where flexibility in well tophole locations is required to maintain ease of drilling, management of collision risk and ensure optimum well placement;
- Ease of fabrication and hence the ability to take account of design changes later in design and/or field life;
- Drilling programme decoupled from subsea structure delivery; and
- Well proven concept West of Shetland.

The FPSO design and selection process covered the full range of hull forms including redeployment, hull conversion and new-build options. When compared to alternative Sevan-type cylindrical hull units, a new build ship-shaped was selected based on:

- Proven ship-shaped performance in West of Shetland and North Sea environments;
- Greater topside flexibility for process design and maintenance;
- Improved contracting options and fabrication yard availability; and
- Operator familiarity and experience with ship-shaped designs, reducing delivery risk.

Overall, the Ship-shaped FPSO offers the most competitive , practical, and reliable option for the Cambo Project.

The majority of the atmospheric emissions from an offshore oil and gas installation come from the need to maintain a reliable power supply for production, maintenance of safety / life support and environmental protection systems.

Seven principal power supply options for the proposed Cambo host facility were considered with the above in mind:

- Onshore power generation from non-renewable sources and import from shore;
- Onshore power generation via renewable sources and power import via cable from shore;
- Offshore renewable energy;
- Offshore generation by a third party with cable import to Cambo;
- Combined Cycle gas turbines;

- Local host facility gas turbines – conventional offshore power generation using gas turbines and produced gas from the Cambo field; and
- Local host facility gas turbines with local Carbon Capture and Storage.

Each concept was examined to determine its suitability for the proposed field development with the selected option, local host facility gas turbines, identified as the only technically and economically viable option, currently available.

Oil and Gas Export

Oil export via shuttle tanker was selected based on lack of existing oil export infrastructure in the area and flow assurance issues associated with dry oil export from Cambo.

In terms of oil offloading to shuttle tanker, tandem offloading was selected as the lowest risk and complexity option.

The following options were considered for disposal of hydrocarbon gas produced in excess of fuel requirements for Cambo:

- Pipeline export to shore for processing/distribution;
- Offshore sale to third party – sale of excess produced gas to other nearby fields that may be gas deficient;
- Gas to Products – processing of gas to alternative liquid gas/other products;
- Gas to Power – offshore power generation and export to other users;
- Gas reinjection to a non-producing horizon; and
- Operational flaring.

Gas export by pipeline to shore was selected, allowing Ithaca Energy to bring the excess Cambo produced gas to market. The gas export pipeline would also provide a source (through import from the host pipeline system) of fuel gas to support initial start-up and to provide efficient recovery from production shutdown/blowdown. The availability of import gas is particularly important once Cambo production has declined such that the field becomes fuel gas deficient. The latter two points will help to minimise reliance on liquid fuel import and consumption.

Key environmental considerations considered during the route selection process included the geometric features associated with all routes; the primary feature being the Continental Shelf to the Faroe-Shetland basin, soils, flora/fauna, existing pipelines/cables and approaches to the tie-in points. In addition, installation of the export pipeline considered specific aspects and areas of potential risk, including environmental issues (some of the proposed pipeline route options transited the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA)).

A pipeline connecting with the Rosebank gas export pipeline to the northeast was found to represent the most suitable host for the Cambo gas export pipeline system. This option represents the shortest pipeline route and is one of the simplest to execute as there is a tie-in point available. Additionally, this route avoids transiting through the Faroe-Shetland Sponge Belt NCMPA.

No pipeline protection such as rock placement is required due to the depths at which the gas export pipeline will be laid. The gas export pipeline will require to crossover up to two existing submarine cables with each crossing point requiring placement of six concrete mattresses for protection.

Local Environment

Information about the environment at the Cambo field development and its surroundings was collated to allow an assessment of those features that might be affected by the proposed operations, or which may influence the impact of any of these operations. The key sensitivities of the areas are summarised below.

Environmental Surveys Relevant to the Proposed Cambo Development

Numerous environmental surveys have been conducted in Quadrant 204 and 205, and in the surrounding quadrants, over the past 29 years (Figure 3). These surveys provide useful information on the seabed sediments and the animals living in and on the seabed (benthos) in the area, including any potentially sensitive features that could be classified as Annex I habitats, under the EU Habitats Directive.

Physical Environment

The proposed Cambo field development is located in the Faroe-Shetland Channel, a deepwater channel in the north-east Atlantic which runs between the Faroe and the Shetland Islands.

The ocean current regime in the Faroe-Shetland Channel is very complex due to the bathymetry of the area, the interaction of a number of different water masses, and seasonal variability in water flows. On a broadscale, cold, dense water from the Arctic flows southwest along the bottom of the channel, whilst warmer water from the Atlantic flows over the top to the northeast. Winds in the area are variable throughout the year, and they most frequently originate from the southwest.

The proposed Cambo field development is situated at water depths of between 1,073 m and 1,105 m within the Faroe-Shetland Channel.

Seabed sediments show a general decrease in grain size with increasing water depth, from mixed sand and gravel in the upper continental slope to mud in the deeper basins of the Faroe-Shetland Channel. This was confirmed the survey data, which show that the seabed across the Cambo field development is comprised of mixed sediments, with varying proportions of mud, sand and gravel, alongside some patches of bedrock outcrops of limited extent.

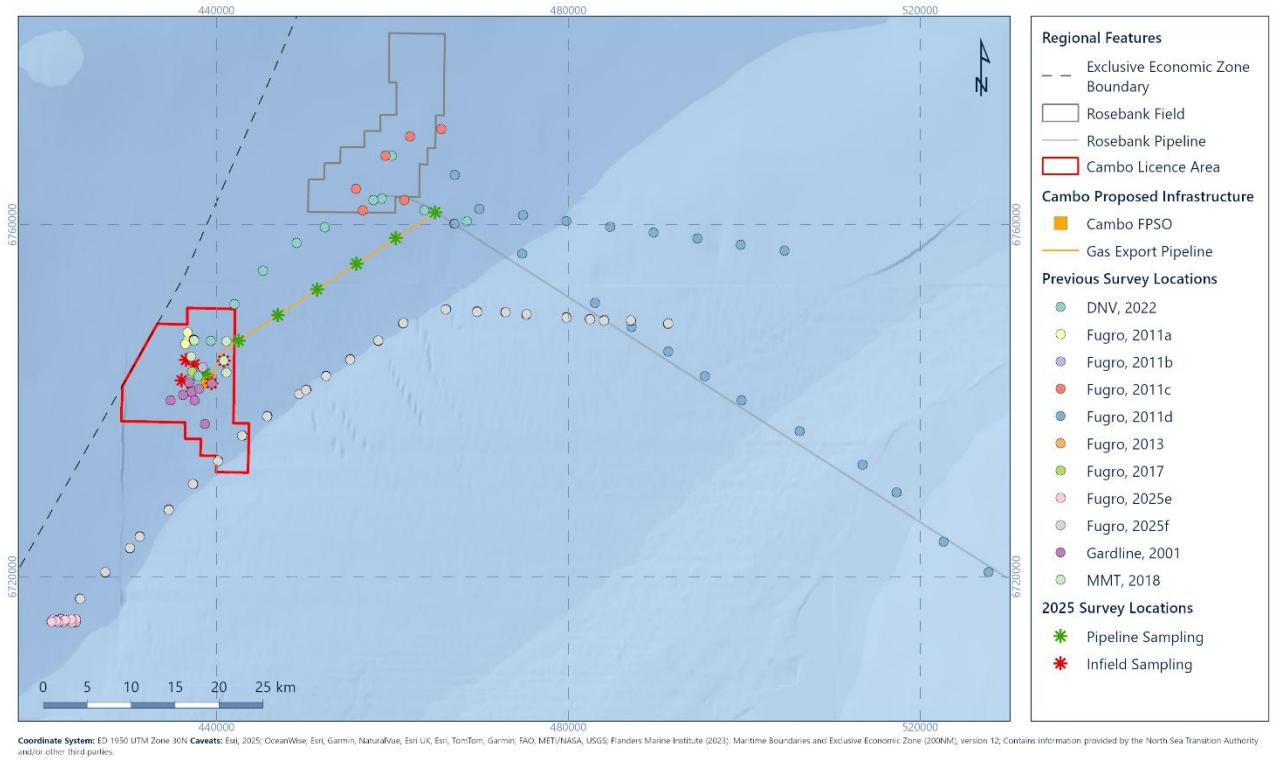


Figure 3: Environmental survey locations relevant to the proposed Cambo field development

Biological Environment

Benthos

Benthos is the term used for animals and plants associated with the seabed, although plants are generally limited by their light requirement to depths of less than 50 m. Benthos consists mainly of animals that burrow into the sediment or form tubes in it (known as infauna). Other species which live on the seabed, or attached to rocks or to other biota, are known as epifauna.

The most recent surveys undertaken in and around the Cambo field development show that the local benthos is made up of a sparse epifauna, with brittlestars, sponges and featherstars being the most regularly observed. The surveys also identified a variety of infauna communities comprising large numbers of polychaetes, which are typical in deep-sea environments of sandy mud in the North Sea.

Even though sponges and corals were reported across the Cambo field development, the qualifying criteria for Oslo and Paris Commission (OSPAR) threatened and/or declining habitats were not met, hence their presence at the proposed development was ruled out.

Plankton

Plankton consists of organisms that drift with the ocean currents and can be divided into phytoplankton (plants) and zooplankton (animals). During spring, an increase in day length and temperature, coupled with the supply of nutrients released during winter mixing of the water column, results in the rapid growth of the phytoplankton population. This phytoplankton bloom is closely followed by an increase in the zooplankton population, as they feed on the increased phytoplankton population. Subsequently,

phytoplankton levels drop throughout the summer months, as the nutrients in the surface waters become depleted and as a result of the zooplankton grazing on them. A second smaller phytoplankton bloom occurs in autumn, but is less pronounced in the open waters West of Shetland than in other areas, such as the North Sea.

Fish and Shellfish

Fish communities in the Faroe Shetland Channel can be broadly split in three vertical zones, which are based on differences in temperature and food availability. The upper slope zone extends from the shelf edge (around 200 m) to approximately 500 m. The fish community of this area includes rabbit fish, redfish and blue whiting.

Between 500 m and 1,000 m lies the transition zone. The sharp temperature gradient in the transition zone supports an unusual fish assemblage dominated by cold water species such as Arctic skate and Greenland halibut. Other species that live in this zone include deepwater demersal species such as redfish and roughhead grenadier.

Below 1,000 m, bottom temperatures are generally less than or equal to 0 °C. This deepwater environment supports comparatively few demersal fish species. The sparse fauna present at these depths includes Arctic skate, rockling, Greenland halibut and deepwater species of eelpout.

There are no spawning grounds which fall directly within the field development footprint. However, predicted spawning grounds for blue whiting are found 10 km to the west. The proposed gas export pipeline route will pass through predicted high intensity nursery grounds for blue whiting. Blue whiting has been designated as Priority Marine Feature, are considered to be of conservation importance in Scotland's seas.

Many of shark and ray species (basking, leafscale gulper and porbeagle sharks; sandy ray and Portuguese and spiny dogfish) which have been identified within or in the vicinity of the proposed field development have been designated as Priority Marine Features.

Marine Mammals

All whales, dolphins and porpoises that occur in UK waters are protected under the EU Habitats Directive, which makes it an offence to deliberately capture, kill or recklessly disturb them. Species which regularly occur in the Faroe-Shetland Channel include Atlantic white sided dolphin, killer whale, long-finned pilot whale, fin whale and sperm whale. Harbour porpoise, common, Risso's and white-beaked dolphin and Northern bottlenose, sei and minke whales are also recorded to a lesser extent, while some species of baleen whale such as blue and humpback are occasionally observed. Blue, fin, sei and sperm whales, are thought to use the Faroe-Shetland Channel as a migratory pathway, swimming through the area to summer feeding grounds in the north, before returning to more southern overwintering and breeding grounds. Many of the whales and dolphin species which have been identified in the Faroe-Shetland Channel have been designated as Priority Marine Features, and the harbour porpoise and blue whale are also listed in the OSPAR list of threatened and/or declining species.

Two species of seal are resident in Scottish waters, the common and the grey seal. These animals are most commonly found in coastal waters shallower than 200 m and are present in internationally important numbers around Shetland. Both species are rarely sighted in the deeper parts of the Faroe-Shetland Channel with telemetry studies noting that neither species is likely to be present around the Cambo field development. Both the common and grey seal have been designated as Priority Marine Features in Scottish waters.

Hooded seals can be found in the Faroe-Shetland Channel area, although, numbers on the whole are low.

Seabirds

The Orkney, Shetland and Faroe Islands and their surrounding waters are sites of major international importance for the seabird colonies they support. The offshore seabirds include members of several families, most notably the petrels and shearwaters, gannets, gulls, skuas and auks. These birds breed on the coasts of the UK, with some feeding far offshore. The Faroe-Shetland Channel is within the maximum foraging range for some species during breeding.

In the winter months, birds become less attached to their nesting sites and range considerable distances in search of food. Seabirds are present throughout the year in the Faroe-Shetland Channel, with mostly low to moderate densities found in the proposed field development area.

Coastal Habitats

Coastal habitats are described in this Environmental Statement, to help assess the potential impacts of a large hydrocarbon spill. As such, not only the relevant parts of the UK coastline have been described below, but also the main coastal characteristics of the Faroe Islands, Norway and Iceland.

The nearest UK land mass to the proposed Cambo field development are the Shetland and Orkney Islands. The proposed Cambo FPSO lies approximately 133 km west of the Shetland Islands and 172 km from the Orkney Islands.

Shetland is an archipelago consisting of numerous islands with extensive and complex coastlines supporting a range of different habitat types. The majority of the Shetland coastline is characterised by either sea cliffs or exposed rocky shores. The coastline of the Orkney archipelago is more diverse than that of Shetland and is generally characterised by a low profile. However, exposed steep sandstone cliffs and stacks dominate the western shores of some of the islands.

The north coast of mainland Scotland predominantly feature steep-sided cliffs with headlands, caves, geos (an inlet, a gully or a narrow and deep cleft in the face of a cliff), blowholes and stacks cut into granite, sandstone and limestone.

The Faroe Islands lie around 152 km northwest of the proposed Cambo FPSO location. The north and west of the archipelago are characterised by sea cliffs, accompanied by small islands, stacks and skerries. These islands are characterised by exposed rocky shores with little intertidal zone, some sandy beaches, but almost no areas of soft, muddy sediment.

The nearest landfall on the Norwegian coast to the proposed field development location is approximately 468 km to the east. The western coastline of Norway is primarily characterised by a network of deep, steep sided fjords, dotted by numerous small, rocky islands and islets.

The nearest landfall on the Icelandic coast is approximately 663 km to the northwest of the proposed Cambo FPSO location. The coastline is characterised by hard bare rock pavement sloping towards the coast and deep fjords forming steep cliffs and rocky shores, with little intertidal zone. Extensive gravel beds are present in the south of the island. These have been reworked via current action to create spits and barrier islands. Extensive mud flats and saltmarshes have developed on the lee side of these barriers.

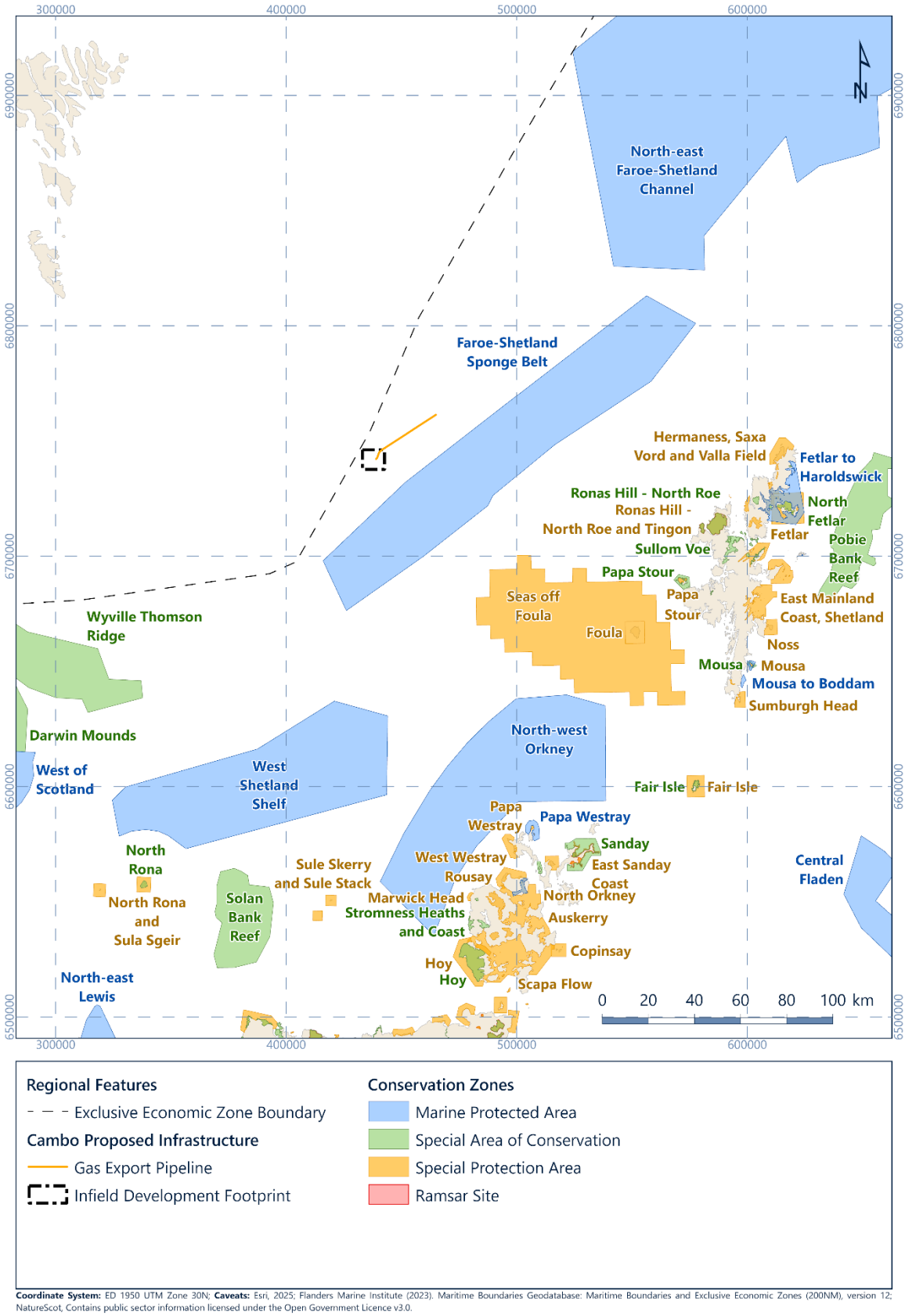
Protected Sites and Sensitive Habitats

There are numerous protected sites along the coastlines of the Shetland and Orkney Islands. These include internationally designated Ramsar Sites (internationally important wetlands of importance, especially for waterfowl), Special Protection Areas (SPA) and Important Bird Areas (protecting rare and vulnerable species of wild birds), and Special Areas of Conservation (SAC) (EC Directive (92/43/EEC) for the Conservation of Natural Habitats and Wild Flora and Fauna 1992 (The Habitats Directive)). There are also numerous nationally designated sites, including Sites of Special Scientific Interest (Figure 4).

The Shetland and Orkney Islands possess many habitats that are either of major conservation importance in themselves or for the species they support. As such, many sites are afforded protection under both statutory and non-statutory conservation designations. The Shetland and Orkney Islands are of international ornithological significance, particularly as seabird breeding sites. Several protected areas can also be found along the Norwegian and Icelandic coasts.

Designated marine sites for conservation, such as NCMPA, are also present in Scottish waters, a few of which are located south and southeast of the proposed Cambo field development (Figure 4). The closest NCMPA to the proposed field development is the Faroe-Shetland Sponge Belt NCMPA which lies 16 km to the southeast.

The closest SPA is the Seas off Foula SPA, which lies 69 km to the southeast of the field development. In addition to these protected areas, the Priority Marine Feature ‘offshore subtidal sands and gravels’, which is widely distributed in UK waters, was identified in and around the proposed Cambo field development.



Coordinate System: ED 1950 UTM Zone 30N; **Caveats:** Esri, 2025; Flanders Marine Institute (2023). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 12; NatureScot, Contains public sector information licensed under the Open Government Licence v3.0.

Figure 4: Offshore and coastal conservation areas in the area of the proposed Cambo development

Other Users of the Sea

The deep waters to the West of Shetland support a deep-water fishery for species such as blue ling, round-nose grenadier, orange roughy, black-scabbard fish and a number of deepwater sharks. The deepwater fishery has little economic significance to the UK fishing industry as a whole. Although fishing effort on the continental shelf to the West of Shetland is quite high and the fishing industry is important to the economy of the Shetland Islands, fishing activity in the deep waters around the proposed Cambo field development location can be considered low. A mixed demersal (i.e. living in or near the seabed) fishery operates year-round and across the northwest of Shetland Islands. Shellfish and herring fisheries are found close to shore. Other pelagic (i.e. living in the water column) fisheries are seasonal and restricted to areas of the continental shelf break and beyond.

Fishing activity around the Cambo field development is considered to be very low compared to activity registered in the wider region, with vessels operating in the area being mostly pelagic trawls and seines.

The waters of the West of Shetland region are relatively undeveloped in terms of oil and gas infrastructure, in comparison with the neighbouring northern North Sea. The Rosebank field is found approximately 23 km north of the Cambo FPSO. The BP operated Loyal, Schiehallion and Foinaven fields are located approximately located around 41 km, 46 km, and 51 km, respectively, to the south of the Cambo FPSO. Various oil fields in the development stage are also located in the wider area around the proposed Cambo field development location.

The Faroe-Shetland Channel experiences very low densities of shipping traffic. A vessel traffic study was commissioned in 2025 within the Cambo area (Block 204/10). This study identified 19 shipping routes which would pass within 18.5 km (10 nm) of the Cambo field development location. It was estimated that these routes were used by a total of 240 vessels each year, corresponding to an average of 4 to 5 vessels per week.

No practice and exercise areas have been highlighted in the vicinity of the proposed Cambo field development.

The closest wreck to the Cambo field development is located 9 km northwest of the proposed pipeline, identified as the wreck of the steam ship Troldfos.

The Faroese Telecom's SHEFA-2 subsea cable crosses the proposed gas export pipeline approximately 22.8 km north of the FPSO and 9.3 km southwest of the end of the proposed pipeline.

Climate Change

As the greenhouse gas emissions to the atmosphere resulting from the Cambo field development will contribute to cumulative global emissions, the baseline greenhouse gas emissions and their effect on climate change are presented at a global scale.

The greenhouse effect is a natural process where Earth's atmosphere traps the Sun's heat, but an increase in carbon dioxide and other greenhouse gas emissions to the atmosphere from human activities can intensify this effect, leading to global warming and climate change. The majority of

emissions are carbon dioxide emissions and come from the combustion of coal, oil and gas, and from the production of metals, cement and other materials.

The UK is a signatory to the Paris Agreement and is required to set out actions to address climate change. In 2019, the UK committed to reach Net Zero greenhouse gas emissions by 2050. Carbon budgets, where a limit is placed on the total amount of greenhouse gas emissions that can be emitted, define how this target will be achieved. The UK has met all three initial carbon budget targets to date, with greenhouse gas emissions having halved since 1990, and the current Sixth Carbon Budget is in line with Net Zero targets.

The level of climate change over the coming decades will be determined by the amount of greenhouse gases that will be emitted. Emissions levels will depend how society grows and develops.

To evaluate the most likely range of potential future global warming levels the Intergovernmental Panel on Climate Change developed 8 future categories, based on possible socioeconomic trends that could shape future society, after running more than 1,200 climate model scenarios. From all these model runs, it picked 5 'illustrative' future pathways, representative of very low, low, intermediate, high and very high emissions scenarios. Global warming will continue to increase in the near term in nearly all considered scenarios. Considerable, rapid, and sustained greenhouse gas emissions reductions are necessary to limit warming below 2 °C by the end of century, with an overall aim of limiting global warming to 1.5 °C.

Several chemical, physical, and biological processes are affected by the increased concentration of greenhouse gases in the Earth's atmosphere. These processes include changes in global temperatures, mean sea level, ocean acidification, ice mass extent, precipitation, and changes in the intensity and frequency of extreme weather events. The rate and extent of these changes will vary depending on the climate scenario followed.

In the UK, climate predictions scenarios show that temperatures are projected to rise. Extreme heatwave events, which impact on people's health and wellbeing, are likely to become more common. Rainfall is predicted to decrease in summer and increase in winter, making periods of water scarcity more common. Sea level rises will be very location specific, but are generally set to increase across the UK.

Assessment of Potential Impacts

Physical Presence Impacts

The proposed Cambo field development will require a range of infrastructure to be installed on the seabed using a variety of vessels. The drilling operations will require a MODU and accompanying support vessels for the duration of the activities. Finally, in the production phase, the presence of the FPSO, support vessel and accompanying safety zones may create obstructions at the Cambo field development area. These have the potential to impact seabed habitats and / or other users of the sea by virtue of their physical presence.

Proposed subsea infrastructure includes, but is not limited to, wellheads, manifolds, umbilicals and flowlines. Two of the planned umbilicals and one flowline will be required to cross an existing subsea

cable. Each crossing will be protected with 6 concrete mattresses (i.e. 18 concrete mattresses for all three crossing points). It is currently planned that infield manifolds and the subsea distribution centre will be installed on the seabed under gravity i.e. using the weight of the structure to partially penetrate the seabed sediment, although alternative foundations will also be considered depending on the results of a geotechnical survey.

A new gas export pipeline is proposed to be installed across 32.5 km of seabed between the proposed Cambo field development and the Rosebank gas export system (subject to commercial negotiations). The proposed pipeline will be surface laid and will traverse up to two existing submarine cables, which will each be protected by up 6 concrete mattresses. The FPSO will be secured to the seabed using suction anchor piles tethered by anchor chains and polyester mooring lines.

As part of the installation operations, the anchor chains and mooring lines will be temporarily stored on the seabed for up to one year. Some of the subsea infrastructure may also be temporarily located within laydown areas on the seabed prior to installation. Furthermore, some of the seabed infrastructure will also be temporarily secured to the seabed using suction anchor piles.

The presence of infrastructure on the seabed associated with the proposed Cambo field development may result in permanent habitat take of 0.0222 km^2, habitat alteration of 0.0005 km^2, and seabed disturbance of 0.0108 km^2. An area of seabed, up to 0.0141 km^2, may also be temporarily disturbed for up to one year.

The Cambo field development traverses an area of 'offshore subtidal sands and gravels' 'Priority Marine Feature' habitat. The spatial extent of the predicted effects of the infrastructure installation and operation will be very small within the context of the wider habitat, as it is widely distributed in UK waters. Effects of habitat take, habitat alteration, and seabed disturbance will last for as long as the infrastructure remains in place. A Comparative Assessment will be undertaken to assess all potential decommissioning options available for the gas export pipeline at the time, including complete recovery of the pipeline as well as leaving sections of the pipeline in-situ. Therefore, effects of the physical presence of the proposed field development on this feature will be long term, but will be highly localised and will have no significant effects on the conservation of this 'Priority Marine Feature' habitat.

Any effects on other local seabed communities will be very small in size and will last for the duration of the development, for as long as the infrastructure remains in place. Impacts will cease on decommissioning when any infield infrastructure placed upon the seabed will be removed, after which the seabed communities are expected to recover to baseline conditions over time.

The proposed location of the FPSO, infield infrastructure, and gas export pipeline is not associated with significant fishing or other shipping activity and so is unlikely to permanently displace or interfere with fishing, shipping, and navigation. Some temporary exclusion from fishing grounds around the immediate area of the pipelaying vessel may occur during pipe laying during the pipe laying operation, estimated to be 27 days. Also, the pipe laying vessel will be continuously moving along the pipeline route and so long-term obstruction and exclusion at any one location will not occur. Effects on fishing, shipping, and navigation due to the physical presence of the proposed field development are therefore considered to be not significant.

Best Practice

Safe working distances will be imposed during installation activities and 500 m safety zones will be put in place around the FPSO and infield infrastructure. The 500 m safety zones will be enforced during operations by a dedicated Emergency Response and Rescue Vessel.

All construction vessels will be highly visible and display the appropriate light or daytime signals to warn other sea users of their presence and activities. When installed, the FPSO will also be highly visible and be in full compliance with the necessary Class and UKCS legal requirements for identification, lighting and sound signals to alert all approaching vessels of its presence. Consideration will also be given to installing reflectors on the mooring ropes of the FPSO to allow fishing vessels to avoid entanglement with the FPSO.

A Vessel Traffic Study was carried out within the Cambo area (Block 204/10), which will be reviewed and, if required, updated prior to inform any application for a Consent to Locate ahead of drilling and installation operations commencing.

A Notice to Mariners will be issued prior to the wet storing of anchor lines on the seabed and to the FPSO and MODU moving onto location, ensuring that all vessels, including fishing vessels, will be aware of its presence in advance and for the duration of operations. In addition, Kingfisher will be notified of the exact location of the FPSO and MODU activities and the planned installation operations allowing inclusion in their fortnightly bulletin to fishing vessels. The Hydrographic Office will also be notified as to the location of the FPSO and the gas export pipeline so that these can be marked on navigational charts.

Atmospheric Emissions

Atmospheric emissions will be produced during drilling, installation and production operations, as a result of power generation onboard the MODU and FPSO, as well as on the standby vessel, supply vessels, subsea construction vessel, pipeline laying vessel and helicopter activity. There will be no routine flaring or venting from the FPSO, but some limited non-routine flaring may be required occasionally, for example during process upsets. In addition, emissions will be generated during the transportation, distribution and processing (refining) of the produced Cambo hydrocarbons and ultimately also during the combustion of the processed/refined oil and gas products by the end user. All these emissions will contribute to local, regional and global environmental effects. At the Cambo field development, the local and regional level air pollution impacts will be very minor and are mitigated by health and safety measures in place to control emissions onboard the vessels, as well as by the dispersive nature of the offshore environment (i.e. the wind and weather conditions). Additionally, in combination with all other emissions in the world, the emissions will also contribute cumulatively to global climate change effects.

The most commonly used general indicator for global climate change is the global warming potential, expressed in tonnes of carbon dioxide equivalents. The global warming potential can be used to estimate the potential future impacts of gaseous emissions, upon the climate system. Carbon dioxide equivalents are a unit of measurement for climate change potential, which enables various different emission gases to be compared in one single unit.

In 2024, a total of 11.8 million tonnes of carbon dioxide equivalent were released from the UK upstream oil and gas industry. The overall GHG emissions during the drilling, construction and commissioning phase of the Cambo development vary between 31 thousand tonnes CO_2e in 2028 to 351 thousand tonnes CO_2e in 2030, when Cambo starts producing. The peak in emissions in 2030 is strongly influenced by well clean-up and commissioning flaring operations which make up 42 % of this total. Once in full production, from 2031 onwards, the annual upstream emissions from Cambo will average around 130.3 thousand tonnes of CO_2e per year, over the life of field. Therefore, compared to the 2024 data, Cambo's emissions in relation to the whole of the UK oil and gas upstream sector will contribute up to 2.97 % during its peak year in 2030 and 1.10 % on average per year from 2031 to 2055.

In addition to these upstream emissions, the assessment also takes into consideration the 'downstream' emissions of the produced oil and gas, once they leave the Cambo FPSO. These downstream emissions cover the transportation, distribution and processing (refining) of the produced Cambo hydrocarbons (14,873 thousand tonnes) and ultimately also during the combustion of the processed/refined oil and gas products by the end user (82,337 thousand tonnes CO_2e).

Therefore, it is estimated that an overall total of up to 100,979 thousand tonnes CO_2e will be generated over the life of field of the proposed Cambo development when both the downstream and upstream emissions are combined. All these emissions will contribute to local, regional and global environmental effects. All Cambo associated emissions taking place on the UKCS or in the UK itself, will contribute a small part of the projected annual UK target carbon budgets set and will remain in line with the Balanced Pathway strategy towards Net Zero by 2050. As the Cambo field development is projected to continue producing hydrocarbons up to 2055, Ithaca Energy will meet all necessary legal and industry-wide agreed greenhouse gas removal requirements that may be implemented by the UK government and Offshore Energies UK (OEUK) to offset industrial GHG emissions produced after 2050 in support of the UK's Net Zero commitment.

The assessment of greenhouse gas emission impacts differs from the other impacts assessed in this Environmental Statement, as they contribute to cumulative global effects, rather than having a direct impact affecting a discrete localised area that can be directly attributed to a specific emission source. As such, the impact assessment for climate change impacts is not based only on whether a project emits greenhouse emissions or the magnitude of greenhouse emissions, but rather how it contributes to the energy transition with the aim of reducing overall greenhouse gas emissions relative to a comparable baseline consistent keeping within internationally agreed and UK government and the industry specific targets, of achieving Net Zero by 2050 in order to limit warming below 2 °C by the end of century, with an overall aim of limiting global warming to 1.5 °C.

Given that global climate change emissions span the entire planet, the receptors sensitivity score for all greenhouse gas emissions, regardless of size or location is classed as 'high'. When reviewing the Cambo emissions against industry specific, UK national and international emission reduction and global warming reduction targets, it can be concluded that the Cambo emissions are most likely to be in line with a climate pathway that limits warming to 2 °C by 2100 but exceeds warming of 1.5 °C during the 21st century. Consequently, the overall cumulative effect on global climate change of all Cambo emissions is minor and therefore may be considered as not significant. The greenhouse gas emissions

impacts associated with the Cambo field development are consistent with applicable existing and emerging policy requirements and good practice design standards for this type of development. The amount of GHG emissions that will be generated by the proposed Cambo field development fit in with a projected emissions pathway to achieve the UK's (as well as the global) climate targets by staying on a trajectory towards net zero and limiting global warming below 2 °C by the end of century, with an overall aim of limiting warming to 1.5 °C.

Mitigation

Ithaca Energy's Net Zero targets are fully supportive of national and industry targets set by the UK government and the industry body OEUK. The Cambo FPSO will therefore be designed with these targets in mind. For example, the FPSO will be designed to accommodate the installation of future electrical infrastructure to facilitate electrical power import and eventual replacement (in whole or in part) of the proposed gas-turbine driven power and heat generation system.

During the drilling and subsea installation activities the use of vessels will be optimised in order to minimise the number of vessel trips and their length of time present at the Cambo field.

When scheduling the drilling operations, optimising fuel use will be considered, including batch drilling of the wells and the use of two drilling units during the summer months, for example, to minimise fuel use.

Low sulphur diesel will be used in accordance with International Maritime Organisation requirements.

Once drilled and ready for production, the Cambo wells will be temporarily shut in (i.e. closed off), so that they can be cleaned up after the pipelines are installed and the wells are connected to the FPSO, so that the fluids can be processed through the production stream, minimising flaring during well clean-up.

The combustion plants onboard the MODU and FPSO will be fuel efficient and meet all current emission standards and all equipment onboard will be well maintained according to a strict maintenance regime, including regular monitoring and inspections to ensure an effective maintenance regime is in place. The maintenance regime will ensure all equipment will operate at optimum efficiency and therefore minimise the overall fuel consumption.

For the first several years of production the Cambo FPSO will be powered by its own produced gas, which will help to minimise diesel consumption, and therefore help in the energy transition as gas is a cleaner form of fossil fuel than the diesel that would otherwise be used for power generation. All excess gas produced during the early years of production, beyond the gas required for power generation of the Cambo FPSO, will be exported to shore, thus also contributing to the UK's energy transition to cleaner forms of fossil fuels.

There will be no continuous routine flaring or venting of gas. Non-routine flaring and venting of hydrocarbon gas will be minimised by employing Best Available Techniques / Technology.

Drilling Discharges

During the drilling operations associated with the proposed Cambo field development, various discharges (drilling fluids and cuttings) will be made both directly onto the seabed and at the sea surface. These discharges have the potential to affect the marine environment through both chemical and physical mechanisms. The extent of these discharges has been quantified and the significance of their associated effects assessed.

Effects of discharges on the benthic environment are related to the total quantity discharged and the energy regime encountered at the discharge site, particularly the currents close to the seabed itself. Based on these factors, the discharge of cuttings, mud and cement at the proposed Cambo wells have the potential to cause a localised impact to the benthic environment, primarily through direct physical changes to the seabed.

There is a preference to use CAN-ductors (a prefabricated tophole well section) on all wells, which will remove the requirement to drill the tophole section of the well. However, for any wells where the use of the CAN-ductor is not feasible, conventional tophole sections will be drilled by the MODU instead using a water based mud (WBM) system. This mud system comprises mainly seawater and clay particles to add weight and viscosity to the drilling fluid. The rock cuttings from the borehole and WBM used will be discharged from the open hole on the seabed, as is normal practice on the UKCS and around the world. For the purposes of assessing the effects of drilling discharges, the larger volume of the discharges of drilling all wells with conventional tophole sections has been assessed, to represent the potential worst-case discharge scenario.

Evidence from long-term monitoring at other wells drilled West of Shetland, indicate that recovery of megafaunal assemblages in the wider area will be noticeable after a few years, but full recovery of may take > 10 years.

As a conservative estimate, it is expected that all benthos will be lost within the area with cuttings deposits > 50 mm. Beyond this immediate area of effect, survival rates will increase with decreasing cutting deposition thickness. The cuttings dispersion modelling indicates that the area in which all benthos is expected to be lost, represents a very small fraction of the available local habitat in the wider project area.

A habitat assessment was undertaken in 2025 which indicated the presence of the 'Priority Marine Feature' habitat 'subtidal sands and gravels' across the proposed Cambo field development and the wider area. The habitat was assessed as a 'High' value receptor, due to its' national conservation importance. However, as already mentioned, the effect significance is assessed as not significant, due to the limited extend of discharges being forecasted by modelling to be deposited on the seabed (within a 200 m radius from each well as a worst-case scenario).

The rest of the benthic community reported from the habitat assessment was assessed as a 'Low' receptor value, and the magnitude of effect as moderate due to the forecasted change in habitats and biological communities within the footprint of the development, hence the effect significance of discharges on the communities is not significant.

The deeper sections of the wells will be drilled either with water-based mud or low toxicity oil based mud. All spent low toxicity oil-based muds will either be collected onboard the MODU and shipped back to shore for appropriate disposal or thermally treated offshore and disposed to sea subject to meeting regulatory standards for disposal. Seabeds covered with water-based mud (if used) contaminated drilling discharges generally have a good potential for recovery, over time.

The magnitude of effect from discharges of cuttings and muds from the sea surface in this area of limited extent is considered again as moderate. This is largely attributable to the fact that any cuttings and mud discharged at the sea surface will become widely dispersed as they settle through the water column (1,073 to 1,105 m of water depth at Cambo). The reported benthos is a receptor of 'Low' value, and therefore the effect significance is considered as not significant.

Best Practice

All chemical additives used for the drilling, cementing and well completion operations are regulated under the Offshore Chemicals Regulations 2002 (as amended), which aims to replace chemicals with poor environmental characteristics by more environmentally friendly chemicals. Selection of all chemicals that may be used during drilling cementing and well completion operations will be based upon both their technical specifications and their environmental performance. The use of all chemicals will be minimised, where practicable

The mud and cuttings from the deeper well sections will pass through a mud recovery system to recover as much of the drilling mud as possible. Once reconditioned, this mud will be used again, thereby minimising the amount of drilling mud used. Eventually all cuttings and spent water-based mud will be discharged from the drilling rig close to the sea surface, allowing dilution and dispersion over a large area, thereby minimising the overall environmental impact. This is also in line with the regulations and is general practice on the UKCS and elsewhere in the world.

The discharge of (low) toxicity oil based muds is not allowed on the UKCS. All cuttings contaminated with low toxicity oil based mud will be collected onboard the MODU and will either be contained and shipped to shore for appropriate treatment and disposal or, alternatively, will be thermally treated offshore and disposed to sea. Cleaned cuttings may only be discharged to sea if they contain less than 1 % residual traces of oil by weight and all such discharges will be subject to an Oil Pollution and Control (OPPC) permit.

Finally, the actual mud and chemical usage will be monitored during drilling operations and subsequently reported to OPRED.

Produced Water and Marine Discharges

Produced water will be cleaned up and discharged to sea, due to its potential to 'sour' the reservoir fluids and other potential water injection issues due to the weak rock formations at Cambo. The treatment process will be designed to treat all of the anticipated water production and reduce the residual dispersed oil content in the produced water to a target concentration of 15 mg/l or less (measured on a monthly average basis) before being discharged to sea.

Numerical modelling was undertaken to determine the fate and dispersion of produced water following discharge to sea and to inform assessment of potential environmental impacts. Produced water temperature, ambient current conditions, discharge direction and depth of release are the factors dictating produced water plume dispersion.

Under typical conditions the desired dilution factor of 400 is achieved from 187 m and up to 4,404 m for all simulations. Modelling indicated that the behaviour of produced water plumes is highly sensitive to discharge configuration. Using the best practices found below the desired dilution factor of 400 will be achieved in a notably lower distance rather than 4,404 m away from the point of discharge.

Significant interaction with seabed sediments and communities are highly unlikely due to the rapid dilution rates within receiving waters and the buoyant nature of the plumes so that they will remain near the sea surface. Other oil and gas facilities are located far beyond the point at which plumes are diluted to below the Risk-Based Approach threshold such that potential mixing of respective plumes and potential synergistic effects are highly unlikely to occur.

Significant effects of the discharge of produced water on benthic and water column communities either alone or cumulatively with other discharges in the region are not expected.

The potential of marine invasive non-native species being released to the water through ballast water discharges was assessed. Marine invasive non-native species encompass a variety of marine plants, fish, microorganisms and invertebrates that are not native to a particular region, but have nonetheless been able to establish themselves to the exclusion of native species.

The impact of any marine discharge (ballast water release) from the use of a MODU or FPSO coming from international waters was assessed as a worst-case scenario on the receiving water column communities, during the different stages of the development. The introduction of marine invasive non-native species may decrease the diversity and abundance of native species. However, considering that the marine invasive non-native species recorded around Shetland are from coastal waters, as well as the remote location of the proposed Cambo field development, the impact is considered as not significant.

Significant effects on the interests of the Faroe-Shetland Sponge Belt NCMPA are also not forecasted to occur and associated conservation objectives are not expected to be significantly affected.

Best Practice

No significant effects on benthic and water column communities are predicted due to the proposed produced water and marine discharges, and mitigation is thus not considered as being required. However, the produced water modelling indicated that the behaviour of produced water plumes is highly sensitive to discharge configuration. Moreover, marine invasive non-native species might be present in the ballast water of the MODU or FPSO (if selection of any of the two is outside the wider Shetland region). Therefore, the following best practice initiatives are provided:

- Reducing the discharge temperature to 27 °C during discharging of produced water from the FPSO. This counteracts the buoyancy for a certain period, thus lengthening the near-field dispersion phase which translates to higher dilution both in the near and far field;

- A downward orientation of 30° of the discharge caisson and release depth of 9 m will also assist with the above helping to reduce any potential impacts on the environment;
- Compliance with the International Maritime Organisation Ballast Ballast Water Management Convention (install and operate approved ballast water treatment systems);
- Conduct ballast water exchange in designated offshore areas and maintain a Ballast Water Record Book;
- Ballast water treatment and management plans should be approved and followed;
- Use of anti-fouling coatings;
- Cleaning of sampling equipment prior to use offshore; and
- Use of vessels from within the region.

Underwater Noise Impacts

Underwater noise will be generated during the three distinct project phases of the Cambo field development. Noise generating operations include the MODU, support vessels and helicopters in the drilling phase, installation vessels for the subsea infrastructure and gas export pipeline during the construction / installation phase and operational noise from the FPSO, support vessels and shuttle tankers during the production phase. Furthermore, a Vertical Seismic Profiling (VSP) survey may be undertaken to gather data on the optional appraisal well (if this goes ahead) which involves the use of a small air gun array emitting sound over a period of approximately 1 day. No piling operations are proposed.

A number of species of marine mammal are considered to be present in the area of the planned Cambo field development including, but not limited to, Atlantic white-sided dolphin, minke whale, killer whale, long-finned pilot whale and sperm whale. These species, and other marine mammals, use sound in various important contexts, such as in social interactions, foraging, and response to predators and hearing is their primary sensory system. Due to their hearing abilities, marine mammals and fish are at risk from significance levels of underwater noise. Furthermore, fish species may also be at risk from increased levels of underwater noise arising from operations due to the Cambo field development.

The underwater sound produced by the FPSO itself, along with support vessels, the shuttle tankers and the MODU are 'non-impulsive' sounds at relatively low frequencies. In contrast, the seismic airgun array used in the Vertical seismic profiling survey will produce intermittent, 'impulsive' sound pulses which are more intense than the continuous noise emitted by most industrial noises in the ocean, including those from the FPSO, MODU or their support vessels.

Noise emissions from the airgun array are not anticipated to give rise to physical injury to marine mammals unless they are within 100 m of the sound source. The underwater noise from the airgun array may evoke some behavioural responses from cetaceans up to a range of 560 m from the sound source. The non-pulsed sounds from the MODU, FPSO and other vessels may evoke some behavioural response in cetaceans up to approximately 1.5 km from the source. Injury to fish from the Vertical seismic profiling survey is predicted to only occur within a few metres of the sound source (≤ 35 m). Given the small distances over which these effects occur and, in the case of the Vertical seismic profiling survey, the short duration of the activity, no significant effects are anticipated.

No significant in-combination, cumulative and/or transboundary impacts from underwater noise generated during the Vertical seismic profiling survey, drilling, pipeline installation, and vessel operations are anticipated.

Mitigation

The planned VSP will be undertaken in line with the Joint Nature Conservation Committee guidelines for minimising the risk of injury to marine mammals from geophysical surveys. Specific mitigation measures that will be employed include operating the survey equipment at the lowest practicable power level needed to undertake the survey, use of a trained Marine Mammal Observer to undertake visual observations for marine mammals and the use of 'soft-start' procedures where the survey equipment is gradually powered up in a uniform manner. A pre-shooting search for marine mammals within a 500 m mitigation zone will also be undertaken.

Waste Management

Small quantities of waste will be produced throughout the development's lifespan, which require appropriate management procedures to be implemented to ensure correct disposal.

Waste such as cements, chemicals, scrap metals, and wood will be generated during drilling and installation activities as well as food waste, recycled materials and waste oils. Decommissioning activities will also generate both hazardous and non-hazardous waste. All waste generated during the development will be minimised through appropriate controls measures and will be properly segregated for recycling, disposal, and treatment once returned to shore.

Ithaca Energy will ensure that waste management will be undertaken in line with best industry practice, current environmental legislation and the Waste Hierarchy. Additionally, any waste will be recorded in the UK Environmental Emissions Monitoring System. All waste produced will be managed in compliance with Ithaca Energy's Waste Management Procedures whilst waste generated onboard vessels will be governed by each vessel's Waste Management Plan.

No significant impacts (including in-combination, cumulative or transboundary impacts) are anticipated as a result of the Cambo field development.

Mitigation and Best Practice

Mitigation and best practice measures that will be implemented regarding waste management are as follows:

- Application of the Waste Hierarchy to all produced waste;
- Compliance with Ithaca Energy's Waste Management Plan and use of a Garbage Management Plan for the management of waste produced from vessels;
- Compliance with Ithaca Energy's Waste Management Procedures for waste produced during the proposed development activities;
- Segregation, transfer onshore and disposal of waste through licensed contractors and sites; and
- Reporting of all waste generated offshore in the UK EEMS.

Accidental Events

The risk of an accidental hydrocarbon spillage to sea is often one of the main environmental concerns associated with oil-industry activities. Spilled oil at sea can have a number of environmental and economic impacts, the most conspicuous of which are on seabirds and coastal areas. The actual impacts depend on many factors, including the volume and type of hydrocarbon spilled, the sea and weather conditions at the time of the spill, and the oil spill response.

The risk of a large-scale hydrocarbon spill during drilling operations or the subsequent production phase of the proposed Cambo field development is very low.

Oil spill modelling shows that a large spill, such as from a well blow-out or a complete loss of inventory from the FPSO, would, under the majority of meteorological circumstances, drift northeast of the proposed well location. A large oil spill would have the potential to reach the coasts of Shetland, Orkney, Faroe Islands or Norway, and during spring and summer time there would be a small probability of oil beaching on the north coast of mainland Scotland and the Isle of Lewis as well. These conclusions are based on modelling results which assume no intervention in response to the slick. In practice, oil spill response resources would be mobilised immediately if a spill occurred. It would be a priority for Ithaca Energy and the Installation/Well Operator to attempt to ensure no spilled oil would impact the coastline and, therefore, all appropriate oil spill response techniques would be employed in the event of a spillage moving towards the shore.

It should be noted that these potential impacts would only occur under extreme circumstances in the event of a very large oil spill. Historic data on oil spills from MODUs and FPSOs operating on the UKCS show that there have only been 2 crude oil spills of such a large size (112 tonnes and 685 tonnes) in the period 1990 to 2024. These spills happened in 1990 and 1997. Historic data suggest small spills of less than 1 tonne represent the most likely spill scenarios.

Throughout the life of development, the focus will be on the prevention of oil spills. Stringent safety and operational procedures will be adhered to throughout the operations. Procedures will be in place to ensure that immediate and appropriate action is taken in the event of any hydrocarbon spillage, minimising any impact to the marine environment. Ultimately, the type and size of spill, along with the meteorological and oceanographic conditions at the time of the spill, will dictate which resources are most suitable for the spill event.

With the measures in place to prevent an oil spill incident from happening and the oil spill contingency planning and response resources available to the Installation Operator in the event of a large oil spill event, the residual environmental risk posed by the proposed Cambo field development is judged to be not significant.

Under extreme circumstances, the FPSO, MODU, a support vessel or a helicopter may sink. These events are extremely rare and happen so infrequently that no reliable statistics could be obtained to quantify them. There are mitigation measures in place for preventing such an event.

In the event of the loss of the FPSO, the MODU, a support vessel or a helicopter, it would be unlikely that the vessel or aircraft would be salvageable in this deepwater environment and, therefore, would

most probably remain on the seabed as a wreck. Attempts would be made to salvage any remaining hydrocarbons and other potentially harmful products onboard the vessel/aircraft, although it should be noted that, in practice, these types of operations are prone to causing pollution incidents. The wreck would be marked on navigational charts to prevent the snagging of fishing nets and other towed equipment. In general, the presence of wrecks on the seabed is not considered to have any long lasting negative environmental effects. Therefore, given the remote chance of such an event happening due to appropriate mitigation measures in place, and minimal negative long-term environmental impacts, the residual impact of a loss of rig is considered to be insignificant.

Mitigation

In order to prevent an oil spill occurring, stringent safety and operational procedures will be followed at all times. Specific mitigation measures include:

- Ithaca Energy will fully assess the competence and experience of all contractors including the Installation Operator, and the suitability of all equipment to operate in the West of Shetland area. All offshore personnel will be appropriately trained, experienced and certified to carry out their specific duties. The crew of the FPSO and the MODU will also undergo environmental awareness and safety training;
- A thorough and formal peer-review approach will be used to review all critical elements of the well designs and the execution of drilling and abandoning the well. In addition, the well designs will be independently reviewed by a Well Examiner. The Well Examiner will also monitor the actual construction and any modifications to the wells. Any change or deviation to the drilling programme, the subsurface parameters for the well design, or the well construction itself, will be subject to a formal management of change process;
- Well control procedures will be in place, to prevent uncontrolled well flow to the surface and a full risk assessment will be performed as part of the planning phase of each well. Data on well pressure will be monitored throughout the drilling operations;
- A blow-out preventer will be put in place. In addition to the standard control systems, the blow-out preventer typically has several other backup emergency control systems;
- The blow-out preventer will be independently inspected and verified periodically. Regular testing of the blow-out preventer and its back up systems takes place onboard the MODU, typically at 7 and 21 day intervals;
- Vessel audits will be performed to confirm sea worthiness of supply vessels and shuttle tankers, and only DP vessels will be used. Bunkering and offloading operations will only take place in suitable weather conditions, and with a dedicated and continuous watch posted at both ends of the fuel/offloading hose. All hoses used during bunkering/offloading will be segmented with pressure valves that will close automatically in the event of a drop in pressure. The bunkering/offloading hoses will be stored on reels, to prevent wear and damage. These hoses will be visually inspected and their connections tested prior to every loading operation. Bunkering/offloading procedures will be followed throughout all bunkering / offloading operations;
- The FPSO will be designed with double bottom / doubled-sided hull. In addition, the cargo tanks will be configured with ballast tanks on the outside;

- All equipment used on the FPSO and the MODU will have safety measures built in to minimise the risks of any hydrocarbon spillage. For example, the FPSO and the MODU will have open and closed drain systems in place that will route any operational spills onboard the FPSO or MODU to the slop tanks where they can be contained and recovered. There are also a number of spill kits available to deal with (smaller) spillages. All supply vessels will operate via DP;
- Use of ROV to identify the source of subsea spill. If at any time the safety of the MODU becomes compromised, the first priority will be to close the blow-out preventer, disconnect the MODU from the well, and move off location. The blow-out preventer is designed as fail safe closed, ROV and acoustic overrides are available should this not work correctly. The ROV can be deployed to verify the BOP is properly closed;
- A contingency stock of cement and barite will be kept onboard the MODU;
- In the event of a subsea blow-out, whereby the blow-out preventer has failed and oil is freely flowing into the sea, the possibility of fitting a temporary capping device to the well will be considered;
- Ithaca Energy is a member of Oil Spill Response Ltd, which allows Ithaca Energy access to the Oil Spill Prevention and Response Advisory Group Capping Device;
- In the extremely unlikely event where a blow-out situation occurred and all options to kill the well failed, the only remaining option to bring the well back under control to stop the spill may be to drill a relief well. Ithaca Energy and the Well Operator will comply with the Offshore Energies guideline "Relief Well Planning for Offshore Wells – Issue 3";
- Planning for the relief well will include a review of the original well design and the reasons for the uncontrolled well blow-out, allowing any required changes to well design, equipment and operating procedures to be implemented. Preparation of equipment, procedures and consent applications will all be conducted in parallel with the activities required to gain access to a suitable replacement drilling unit;
- Several alternative relief well locations around the Cambo Field will be identified in the Relief Well Plan;
- If a large well control incident were to occur, it would be a priority to avoid spilled hydrocarbons impacting the coastline and, therefore, all available and suitable oil spill response techniques would be employed in the event of a spillage moving towards the shore;
- Ithaca Energy will ensure that any MODU working in the Cambo field has an approved Non Production Installation Oil Pollution Emergency Plan (NPI OPEP) in place as well as a Temporary Operations Oil Pollution Emergency Plan (TOOPEP) to cover the planned drilling operations. During production operations, Ithaca Energy will have a Cambo Field (Tier 1) OPEP in place;
- The NPI OPEP, TOOPEP and Field OPEP will all conform to the Merchant Shipping (Oil Pollution, Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. The NPI OPEP, TOOPEP and Field OPEP will each fully consider the specific oil spill response requirements for operations at the Cambo field;
- Specific members of the FPSO/MODU and standby vessel crew will have undertaken OPEP level oil spill response training. The Offshore Installation Manager and the Installation/Well Operator

offshore representatives will have undertaken the OPRED course for On-Scene Commander (OPEP Level 1);

- As a minimum, the NPI OPEP, TOOPEP and Field OPEP will be distributed to personnel with designated duties in the event that an oil spill response is required, and to the regulatory authorities and statutory consultees. On receipt of the NPI OPEP, TOOPEP and Field OPEP, personnel will undergo awareness training in oil spill response prior to the commencement of drilling operations;
- The FPSO and MODU will regularly undertake training exercises, including vessel-based oil spill response exercises for the crew and an Offshore TOOPEP Exercise while on site. Similar offshore exercises will be held periodically for the FPSO's OPEP, once it is in operation;
- External oil spill response training will be organised for key onshore personnel, in line with the OPRED requirements and the internal requirements of environmental training and continual improvement in the Well Operator's Management Systems. Relevant Ithaca Energy and Installation/Well Operator Duty Managers will, as a minimum, have undertaken the OPRED course, Corporate Management oil spill response awareness (OPEP Level 2). Ithaca Energy is a member of Oil Spill Response Ltd, with activation rights being provided to the Installation/Well Operator. A response advisor with OPEP Level 4 training would also be provided by Oil Spill Response Ltd;
- Desktop exercises will be undertaken prior to commencement of operations to test the effectiveness of the oil pollution emergency plan;
- The most appropriate response to a hydrocarbon spill from the planned drilling operations will be determined by oil type, logistics and prevailing physical conditions. A precise response strategy can only be decided at the time of the spill. Oil spill response personnel must be prepared to adapt their actions as the spill develops as changes in both the prevailing conditions and the oil properties dictate;
- It is proposed that, in the event of a crude or diesel spill incident, the principal response strategy will be the monitoring and surveillance of the slick, where evaporation and natural dispersion will be the principle mechanisms for removal of oil from the sea surface;
- A standby vessel will be on site at all times during drilling and production operations through the life of the proposed Development. In the early stages of an incident, the slick may be monitored by this onsite standby vessel, provided it can still meet its safety function. For larger, ongoing spills, aircraft may be mobilised to undertake aerial surveillance. However, in the short term, aerial surveillance may be undertaken by the helicopter contractor;
- A contract with Oil Spill Response Ltd will be put in place, allowing the rapid deployment of a dedicated aerial surveillance aircraft;
- Tracking and monitoring of the spilled oil would commence as soon as possible after the incident has occurred and continue for the duration of the response;
- To aid natural dispersion of a large oil spill, or when sensitive receptors such as flocks of seabirds are at risk, Ithaca Energy will consider applying chemical dispersants;
- The use of chemical dispersants may therefore be considered for oil spills which are observed to not disperse naturally. The decision to use chemical dispersants will always need to consider its positive benefits against any resulting impacts in the water column;
- Booms may be used to contain a large slick on the sea surface, concentrating the oil for recovery by skimmers;

- Once the coastal sensitivities under immediate threat have been identified, coastal protection resources will be deployed to protect priority areas. Although Ithaca Energy and the Installation/Well Operator will provide all necessary assistance as required, all shoreline protection strategies will be determined by the local authority in consultation with their environmental advisors;
- Every effort will be made to clean-up up any oil that reaches the shoreline.
- If a spill does reach the shoreline, aerial surveillance will be used to gain a broad overview of where it has beached, while vehicles or vessels will be used to make a more detailed, shore specific assessment. Through Oil Spill Response Ltd, stretches of shoreline will be surveyed, recording the type of shoreline (sediment type, slope, exposure etc), its use (tourism, recreation, etc), and any environmental sensitivities (protected areas, seal breeding sites, otter holts, etc), as well as the severity of any oiling (mobile oil, surface or subsurface oil, stranded oil, sheen etc). Information on access arrangements, parking and storage arrangements, and proximity to other facilities will also be recorded. This information will be used to determine where to focus the clean-up effort by making the optimum use of the available clean-up resources;
- With all required assistance and information provided by Ithaca Energy and the Installation/Well Operator, the strategy for shoreline clean-up ultimately will be directed by the affected local authorities. Adequately trained personnel and clean-up equipment will be made available to assist any clean-up operations, through Oil Spill Response Ltd;
- Ithaca Energy will ensure that it has sufficient finances and insurance in place to cover the cost of responding to a large oil spill.

Overall Conclusions

The only potentially significant environmental impact identified during the environmental impact assessment of the proposed Cambo field development are those associated with a large-scale oil spill. However, the likelihood of such an event occurring is remote and mitigation and management procedures will be in place throughout drilling and production operations to prevent this from happening. Ithaca Energy will also ensure that adequate resources will be in place to deal with any such spill should it occur. Therefore, with these mitigation measures in place the residual environmental risk of a large oil spill is judged to be not significant.

The spatial extent of the predicted seabed disturbance from placement of physical infrastructure on the Priority Marine Feature habitat 'offshore subtidal sands and gravel' will be very small within the context of the wider habitat. The habitat is also one of the most common habitats found in UK offshore waters and it is not limited in its extent to the area of the Cambo field development Therefore, no significant effect on the conservation of this PMF is anticipated.

The discharge of the drill cuttings, drilling mud and cement have the potential to cause localised impacts to the benthic environment. Where possible, CAN-ductors will be used, which will reduce the overall extent and thickness of the drill cuttings. Recovery in the wider area is likely within a few years but within the directly impacted area recovery would be slower. However, the area with a direct impact is relatively small and therefore the effect is not significant.

The proposed Cambo field development will contribute to the United Kingdom's Energy Security by maximising recovery of hydrocarbons from the UKCS. Moreover, the proposed Cambo field development and its associated emissions are aligned with the current energy transition trajectory towards Net Zero by 2050 set out by the UK government as well as with the objectives agreed in the Paris (climate) Agreement.

It is recognised that, in doing so, the proposed Cambo field development will also contribute to global greenhouse gas emissions. These emissions are comparable to similar sized oil and gas developments on the UKCS and the upstream greenhouse gas emissions intensity per produced barrel of oil will be on the lower end compared to all other installations presently operating on the UKCS. Therefore, in this context, the effects on global climate change of the overall contribution of all combined Cambo emissions generated during the drilling, installation, commissioning and operational life of field of the proposed Cambo field development, as well as those generated during the transportation, distribution and processing and end user combustion of the produced Cambo oil and gas products have been assessed as being 'Minor adverse' and therefore can be considered to be not significant.

All other impacts identified in the ES covering the drilling, installation and production phases of the Cambo field development are expected to only have localised impacts with good recovery potential over time.

Overall, no environmental impacts have been identified during the environmental impact assessment process that would result in a significant risk to the environment and therefore Ithaca Energy hereby seeks project consent for the proposed Cambo field development.

1. Introduction

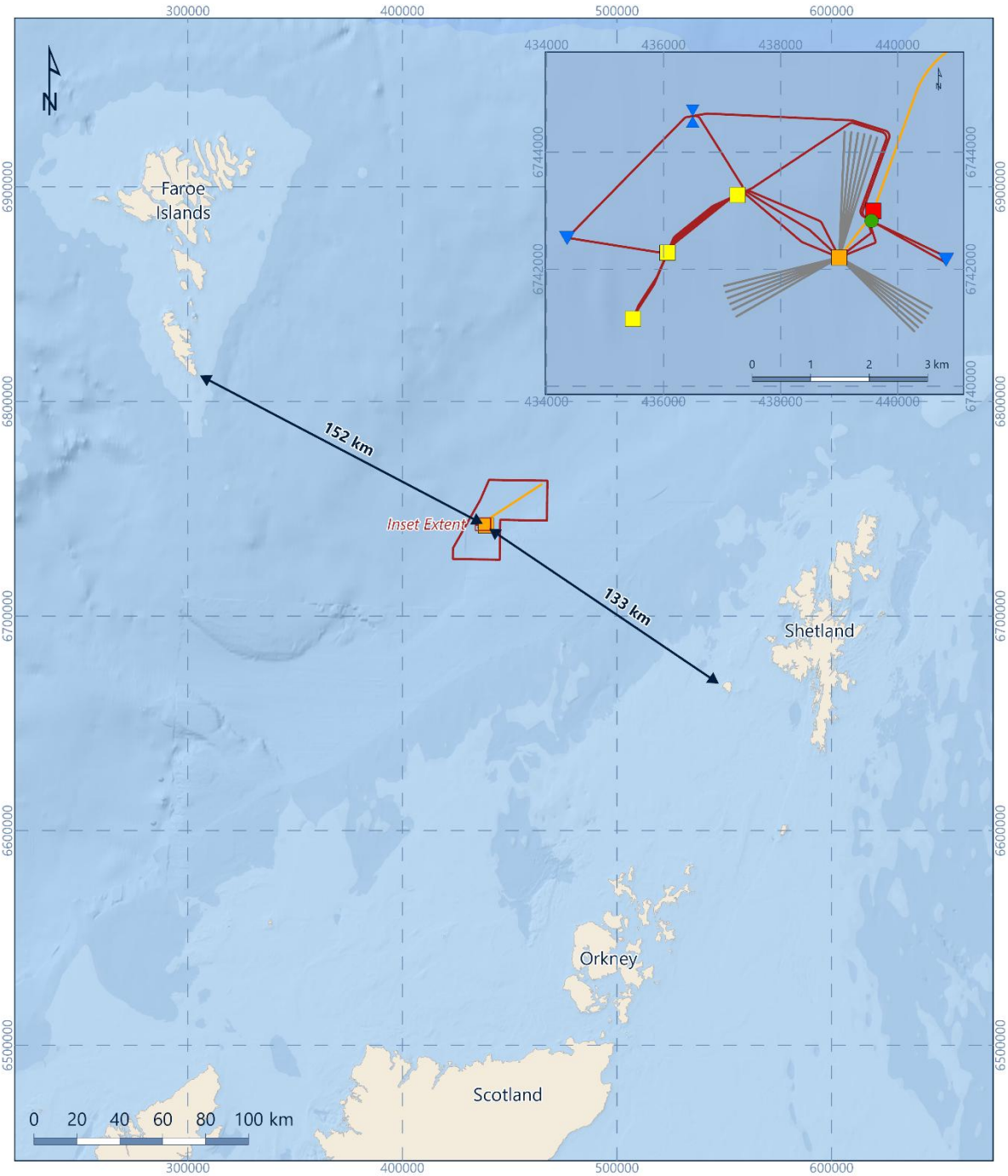
This Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) conducted by Ithaca SP E&P Limited for the development of the Cambo Oil Field in Blocks 204/4a, 204/5a, 204/9a and 204/10a, in the West of Shetland region of the United Kingdom Continental Shelf (UKCS). Ithaca SP E&P Limited is an affiliate of Ithaca Energy (UK) and its affiliated companies, which are collectively referred to as "Ithaca Energy". The proposed Cambo field development is located approximately 133 km to the West of the Shetland Islands in a water depth of 1,073 m to 1,105 m (Figure 1.1).

The scope of the Cambo field development also includes a gas export pipeline extending approximately 32.5 km to the northeast of the Cambo field, to the planned Rosebank pipeline (subject to commercial negotiations).

The purpose of this Environmental Statement (ES) is to present the results of the Environmental Impact Assessment (EIA) for the proposed Cambo field development and to identify the measures which will be put in place to remove or minimise likely significant adverse effects.

This ES has been produced in accordance with the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 and associated guidelines. It also addresses issues and mitigation associated with the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended), the Offshore Chemicals Regulations 2002 and the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended), as well as other relevant legislation.

Ithaca SP E&P Limited is appointed as Well Operator for Cambo. An application to appoint an Installation Operator will be made at a later date.



Coordinate System: ED 1950 UTM Zone 30N; **Caveats:** OceanWise, Esri, GEBCO, Garmin, NaturalVue, OceanWise, Esri, Garmin, NaturalVue; Esri, 2025; Flanders Marine Institute (2023). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 12.

Figure 1.1: Location of the proposed Cambo field development

1.1 Background to the Proposed Cambo Field Development

UKCS Blocks 204/4a, 204/5a, 204/9a and 204/10a are within Licence areas P1189 and P1028, for which Ithaca SP E&P Limited (70% equity) and Ithaca Energy (UK) Limited (30 % equity) are the Licence Operators. Licence P1028 was awarded during the 19th Round of Offshore Licensing in 2001, whilst Licence P1189 was awarded during the 22nd Round of Offshore Licensing in 2004.

An overview of the history of the Cambo oil field from its discovery in 2002, to the latest well drilled in 2018, is provided in Table 1.1.

Ithaca Energy now plans to develop the Cambo field in order to produce the oil and gas contained in the reservoir. The field will be developed using a dedicated, moored Floating Production, Storage and Offloading vessel (FPSO) to produce hydrocarbons from three drill centres. Oil will be exported via shuttle tanker, whilst gas will be exported via pipeline connecting to the Rosebank pipeline and on to the West of Shetland Pipeline System (WOSPS).

Ithaca Energy is currently planning to commence offshore development activities at the Cambo field in Q2 2028 with first drilling operation in Q3 2028. First oil is expected in Q4 2030.

The Cambo field is expected to produce oil and gas for approximately 25 years. Based on the best estimates available to date, the field is expected to produce a total (average annual rate) of 6,439 m^3/d of oil and 664,884 Sm^3/d of gas per day during peak production.

A full description of the planned Cambo field development and production operations is provided in Section 4.

This ES has been prepared in support of the Cambo Field Development Plan (FDP).

Table 1.1: History of the Cambo field

Well Name	Spud Date	Operator	Well Type and Target	Status	May also be Referred to in this ES as:
204/10-1	2002	Hess	Exploration well. Drilled to appraise the Hildasay sands.	Plugged and Abandoned	Cambo 1
204/10-2	2004	Hess	Exploration well. Drilled to appraise the Hildasay sands.	Plugged and Abandoned	Lindisfarne
204/10a-3	2009	Hess	Exploration well. Drilled to appraise the Hildasay sands and to test the presence of pre- and intra-basalt sand potential.	Plugged and Abandoned	Cambo 3
204/10a-4, 204/10a-4Z	2011	Chevron	Appraisal well. Drilled to confirm the amount of commercial reserves in the Hildasay H30 sands. Side track (204/10a-4Z) completed ready for testing.	Plugged and Abandoned	Cambo 4
204/5a-1	2013	Chevron	Appraisal well. Drilled to further evaluate the structure, extent and hydrocarbon bearing potential of the Colsay reservoir.	Plugged and Abandoned	Cambo 5
204/10a-5, 204/10a-5Z, 204/10a-5Y	2018	SPE	Appraisal well. Drilled to reduce remaining subsurface uncertainties, to allow core and reservoir fluids to be tested for system design input/validation. Horizontal side-track (204/10a 5Y) was tested and flowed.	Abandoned – wellhead to be removed in the future.	Cambo 5Y

Notes
SPE = Siccar Point Energy.

1.2 Legislative Framework

The proposed Cambo field development lies outwith UK territorial waters (i.e. greater than 12 nm from land). The majority of the activities undertaken will therefore be governed under the current legislation regarding offshore oil and gas activities. The main legislation applicable to the proposed Cambo field development is summarised in Appendix 1 together with the relevant consents, authorisations and exemptions that are required. An overview of the key legislation is provided below.

1.2.1 The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020

These regulations replace The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) and implement the requirements of EC Directive 2011/92/EC (the EIA Directive) for offshore oil and gas operations in the UK. The EC Directive 2011/92/EU revokes the 85/337/EEC and its amendments 97/11/EC, 2003/35/EC and 2009/31/EC. These regulations require that an EIA must be undertaken for an offshore development considered to fall within the scope of a Schedule 1 project and that a public consultation document (the ES) is submitted to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) and made available to any interested party for comment prior to approval by the Secretary of State (SoS). The assessment of likely significant effects of a project on the environment, must as per Schedule 6(5)(d) of the Offshore EIA Regulations, *"take into account environmental protection objectives established in retained EU law or at national level*".

OPRED has prepared guidance notes on the new regulations, issued in July 2021 (Version 3), which detail the information the ES should contain. In June 2025, OPRED issued a supplementary guidance document, which provides advice on assessing the effects of downstream scope 3 emissions on the climate from offshore oil and gas projects, in response to the Finch judgment, 2024 and subsequent Jackdaw and Rosebank Judgment, 2025.

Essentially, the document must describe the proposed project and identify any impacts that could result in likely significant effects on the receiving environment, together with any measures to reduce the significance of these impacts. Consent for an activity will be granted only once the SoS has considered, and is satisfied with, the environmental information provided (including any significant effects of a project on the environment), any further information submitted to the SoS, representations received during the public consultation and any conditions that may be attached to the agreement to grant consent.

1.2.2 The Offshore Petroleum and Pipelines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017

The Offshore Petroleum and Pipelines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017 came into force on 16 May 2017. These regulations transpose the requirements of Directive 2014/52/EU into the EIA regulations.

Directive 2014/52/EU amends the EIA Directive to strengthen the quality of the EIA process and align the process with smart regulation and improves environmental protection.

1.2.3 The Climate Change Act 2008

In the United Kingdom (UK), the principal basis for giving effect to the reduction of territorial GHG emissions is through the Climate Change Act 2008, which sets binding carbon budgets and a net zero target by 2050 for the UK as a nation. The expectation is that Scope 1 and 2 GHG emissions are assessed by the developer for the impact of the project on climate, which should include consideration of the Climate Change Act 2008, and associated carbon budgets.

The legal definition of net zero as set out in the Climate Change Act is to ensure that the "net UK carbon account" is 100 % lower than the 1990 baseline. This can be achieved through reducing emissions as well as offsetting greenhouse gases, such as planting trees or using carbon capture and storage technologies. This means the total greenhouse gas emissions produced would be equal to the greenhouse gas equivalents removed from the environment.

Although continued extraction of hydrocarbons is supported by the North Sea Transition Deal and the British Energy Security Strategy, among other policies, a concentrated effort must be made to reduce atmospheric emissions from oil and gas installations, including electrification of offshore assets to help decarbonise the sector.

1.2.4 The North Sea Transition Deal

The North Sea Transition Deal (NSTD) is an agreement between the UK government and the oil and gas industry to deliver an orderly energy transition. The North Sea Transition Deal recognises that the oil and gas industry will have a critical role in maintaining the UK's energy security through the transition to net zero carbon by 2050. Government forecasts show that oil and gas will remain an important part of our energy mix for the foreseeable future, including under net zero.

Through the Deal, the oil and gas sector and government will work together over the long-term to deliver the skills, innovation and new infrastructure required to decarbonise North Sea production.

Through the package of measures, the Deal is expected to support up to 40,000 jobs across the supply chain and is expected to cut pollution by up to 60 million tonnes by 2030 including 15 million tonnes through progressive decarbonisation from oil and gas production on the UK Continental Shelf - the equivalent of annual emissions from 90% of the UK's homes.

1.2.5 Offshore Chemicals Regulations 2002 (as amended)

The Offshore Chemicals (Pollution Prevention and Control) Regulations 2002 (as amended) have been developed in response to the Harmonised Mandatory Control System (HMCS) introduced by the Oslo and Paris Commission (OSPAR). The regulations stipulate that operators must hold a permit to use and discharge chemicals offshore. This permit must be in place

before commencement of drilling and production operations. An application for the approval of a permit for the use and discharge of chemicals is made electronically to OPRED through a Chemical Permit-Subsidiary Application Template (CP-SAT) submission. These applications are made using the online OPRED Portal Environmental Tracking System (PETS), and this shall contain:

- A description of the offshore source on or from which the offshore chemical is to be used or discharged, and the location of the offshore source in the relevant area;
- A description of the proposed technology and other techniques for preventing or, where this is not possible, reducing the use or discharge of the offshore chemical from the offshore source;
- A description of the measures planned to monitor the use or discharge of chemicals; and
- An assessment of the risk of damage to the environment from the use and discharge of the offshore chemicals proposed.

Chemical permits require reporting of actual chemical use and discharges on the Environmental and Emissions Monitoring System (EEMS).

1.2.6 The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended)

These regulations, generally referred to as the OPPC Regulations, introduced a permitting system for oil discharges to the sea.

The OPPC Regulations also amend the Offshore Chemicals Regulations 2002 to increase the powers of OPRED inspectors to investigate non-compliances and risk of significant pollution from chemical discharges, including the issue of prohibition or enforcement notices.

In 2011, amendments were made to the OPPC Regulations to align them with amendments made to the Offshore Chemicals Regulations (as described in Section 1.2.3). The amendments make it unlawful to unintentionally release oil into the offshore environment. The amendments also update the definition of a "discharge" as an intentional emission of oil. All oily discharges must be in accordance with the terms and conditions of an OPPC permit.

At Cambo the discharge of any drill cuttings contaminated with reservoir hydrocarbons will be subject to an OPPC permit. During the production phase, OPPC permits will be required for the discharges contaminated with reservoir hydrocarbons, such as produced water, produced sand and scale, for example.

1.2.7 The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended)

These regulations, which were amended in 2007 (Section 1.2.8), seek to ensure that oil and gas activities on the UKCS are carried out in a manner that is consistent with the requirements of the Habitats Directive (92/43/EEC).

These regulations are designed to ensure that the integrity of either a Special Area of Conservation (SAC) or a Special Protection Area (SPA) is not significantly affected by activities occurring either within or outside those sites. Any plan or project which either alone or in combination with other plans or projects would be likely to have a significant effect on a site must be subject to an appropriate assessment of its implications for a site's conservation objectives. Such a plan or project may only be agreed after ascertaining that it will not adversely affect the integrity of a SAC or SPA unless there are imperative reasons of overriding public interest for carrying out such a plan or project.

1.2.8 Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended)

These regulations make provision for implementing the Birds Directive (79/409/EEC) and Habitats Directive (92/43/EEC) in relation to marine areas where the UK has jurisdiction beyond its territorial sea, i.e. everywhere on the UKCS outside the 12 nm zone. The regulations make provision for the selection, registration and notification of sites in the offshore marine area (European Offshore Marine Sites) and for the management of these sites. Competent authorities are required to ensure that steps are taken to avoid the disturbance of species and deterioration of habitats in respect to the offshore marine sites and that any significant effects are considered before authorisation of certain plans or projects. Provisions are also in place for issuing of licences for certain activities and for undertaking monitoring and surveillance of offshore marine sites.

These regulations also make it an offence to deliberately disturb wild animals of a European Protected Species (EPS), in such a way as to significantly affect the ability of any significant group of animals to survive or breed, or the local distribution or abundance of that species. If appropriate, a Wildlife Disturbance Licence may be required.

These regulations were amended in April 2010, altering the transposition of the Wild Birds and Habitats Directives. Draft guidance notes on 'The protection of marine European Protected Species from injury and disturbance' are available on request from the Joint Nature Conservation Committee (JNCC, 2010).

1.2.9 The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019

Due to the UK's exit from the European Union (EU), legislative amendments have been undertaken with respect to some of the main pieces of legislation that afford protection to particular habitats and species in this country. These are the Conservation (Natural Habitats, &c.) Regulations 1994, the Conservation of Habitats and Species Regulations 2017, the Conservation of Offshore Marine Habitats and Species Regulations 2017 and the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001, known collectively as "the Habitats Regulations", as well as The Wildlife and Countryside Act 1981.

In Scotland, these changes are enacted through The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019, which seek to ensure that Scotland maintains the standards required by the EU Habitats and Wild Birds Directives, commonly referred to

collectively as "the EU Nature Directives", which set out rules for the protection and management of certain habitats and species and all wild bird species to ensure their conservation in the long term.

For Scotland and the rest of the UK, the Habitats Regulations continue to remain in force, including the general provisions for the protection of European sites and the procedural requirements to undertake Habitats Regulations Appraisal (HRA) to assess the implications of plans or projects for European sites.

1.2.10 Petroleum Act 1998 (as amended)

The Petroleum Act 1998 establishes the regulatory regime applying to oil and gas exploration and production in the UK (other than onshore in Northern Ireland). The Petroleum Act (as amended) vests all rights to the nation's petroleum resources in the Crown but allows licences to be granted that confer exclusive rights to 'search and bore for and get' petroleum on the UKCS. The vast majority of offshore energy activities relating to oil and gas exploration and production are controlled under the Petroleum Act 1998 (as amended) and the Energy Act 2008 (as amended) or are exempted under the Marine Licensing (Exempted Activities) Order 2011 (as amended).

1.2.11 The Energy Act 2008 (as amended)

1.2.11.1 The Energy Act 2008

The Energy Act 2008 makes provisions for the decommissioning of offshore oil and gas installations. Part III of the Energy Act 2008 amends Part 4 of the Petroleum Act 1998 and contains provisions to enable the SoS to make all relevant parties liable for the decommissioning of an installation or pipeline; provide powers to require decommissioning security at any time during the life of the installation and powers to protect the funds put aside for decommissioning in case of insolvency of the relevant party.

Part 4a of The Energy Act, created through Section 314 of the Marine and Coastal Access Act 2009 (see below), transferred the Consent to Locate provisions of Section 34 of the Coast Protection Act 1949 to the Energy Act. This gives the SoS power to grant Consents to Locate to an individual or organisation under Part 4a of the Energy Act, which would permit installation of an offshore structure, or the carrying out of offshore operations, providing that they are undertaken in accordance with the conditions of any consent granted.

1.2.11.2 The Energy Act 2016

The Energy Act 2016 contains provisions to establish the Oil and Gas Authority (OGA) a new regulatory body for the oil and gas industry in the UK and transfers regulatory powers and functions to it as well as providing it with new powers. The OGA is now known as the North Sea Transition Authority (NSTA), however its remit remains the same.

Further to the establishment of the OGA the Act as makes provisions regarding abandonment of offshore installations which require to have an abandonment programme approved by the Secretary of State in place before any such operations commence. The OGA requires to be consulted before submission of an abandonment programme to allow the OGA to consider and advise in possible alternatives to decommissioning such as reuse of infrastructure.

1.2.11.3 The Energy Act 2023

The Energy Act 2023 became law in October 2024 and implements the goals of a number of energy policies such as the British Energy Security Strategy and the Powering up Britain: Net Zero Growth Plan to increase energy security whilst transitioning to Net Zero.

With respect to the oil and gas sector the Act includes powers to ensure that the regulatory regime for the industry remains fit for purpose by permitting future changes through introduction of secondary legislation. Amendments to cost recovery mechanisms and measures to discourage potentially undesirable changes of ownership and control of assets on the UKCS are also included in the Act.

1.2.12 The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 (as amended)

These regulations implement the provisions of the EU Integrated Pollution Prevention and Control Directive (IPPC) (Directive 2008/1/EC) for offshore oil and gas installations and apply to those structures where combustion plant has a thermal input greater than 50 MW(th). In order to help prevent or reduce atmospheric emissions, the regulations require that a permit be obtained for the installation. In order to receive a permit, the operator must demonstrate that a BAT (Best Available Techniques) assessment has been conducted to ensure that the atmospheric emissions generated by the installation have been reduced as much as practically possible. Consideration should also be given to environmental quality standards, energy efficiency and waste minimisation. Adequate capacity for monitoring and analysis of emissions is required.

Once consent is granted, the permit holder is required to monitor and report emissions to demonstrate compliance with the permit conditions.

1.2.13 The Greenhouse Gas Emissions Trading Scheme Order 2020

Under these regulations, any combustion installation with a thermal input greater than 20 MW(th) (except in installations for the incineration of hazardous or municipal waste) must make an application for a greenhouse gas (GHG) emissions permit. Permits include a requirement to surrender allowances to OPRED that are equal to the total emissions of carbon dioxide from the installation in each calendar year. The holders of permits may buy and/or sell such allowances under the trading scheme.

1.2.14 The Offshore Installations (Offshore Safety Directive (Safety Cases etc.) Regulations 2015

The Offshore Installation (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 came into force on the 19 July 2015 replacing the 2005 Safety Case Regulations. The 2015 regulations apply to all oil and gas operations in UK waters and implement the European Commission (EC) Directive on safety of offshore oil and gas operations 2013/30/EU. The EU has put in place a set of rules to help prevent accidents, as well as respond promptly and efficiently should one occur. The 2015 regulations provide for the preparation of safety cases for offshore installations and the notification of specified activities.

1.2.15 UK Marine and Coastal Access Act 2009

The UK Marine and Coastal Access Act 2009 provides a legal mechanism for improved management and protection of the marine and coastal environment, with particular relevance to biodiversity and nature conservation. This legislation makes provision for the designation of Marine Protected Areas (MPA) in UK offshore waters.

1.2.16 Marine Strategy Framework Directive

The aim of the European Union's Marine Strategy Framework Directive (MSFD) (2008/56/EC) is to protect the marine environment across Europe more effectively. The Marine Directive was adopted by the EU on 15 July 2008 and transposed into Scottish legislation by the Marine (Scotland) Act 2010. The Directive requires Member States to prepare national strategies to manage their seas to achieve Good Environmental Status (GES) by 2020. The MSFD outlines the following 11 high level descriptors of GES in Annex I of the Directive. The proposed Cambo field development is aligned with these descriptors, where applicable.

1. Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions;
2. Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems;
3. Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock;
4. All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity;
5. Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters;
6. Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected;
7. Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems;

8. Concentrations of contaminants are at levels not giving rise to pollution effects;
9. Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards;
10. Properties and quantities of marine litter do not cause harm to the coastal and marine environment; and
11. Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

1.2.17 The Scottish National Marine Plan

EU Directive 2014/89/EU introduced a framework for maritime spatial planning, with the aim to promote the sustainable development of marine areas and the sustainable use of marine resources. In accordance with this Directive, the Scottish National Marine Plan (NMP) was published in March 2015. The Scottish NMP sets out strategic policies for the sustainable development of Scotland's marine resources through informing and guiding regulation, management, use and protection of the Marine Plan areas. Appendix 1 summarises the general and oil and gas specific policies and objectives which are of relevance to the proposed Cambo field development. Ithaca Energy will ensure compliance with all the NMP policies throughout the proposed Cambo field development.

The Scottish Government is currently preparing the Scottish National Marine Plan 2 (NMP2) which was subject to a public consultation in 2024. Adoption of the Scottish NMP2 is estimated to take place sometime in 2025.

1.3 Environmental Impact Assessment (EIA) Process

Offshore oil and gas activities can involve a number of environmental interactions and impacts due, for example, to operational emissions and discharges and general disturbance. The objective of the EIA process is to incorporate environmental considerations into the project planning and design activities, to ensure that best environmental practice is followed and ultimately to achieve a high standard of environmental performance. The process also provides for the potential concerns of stakeholders to be identified and addressed, as far as possible, at an early stage. In addition, it ensures that the planned activities are compliant with legislative requirements and Ithaca Energy's own management procedures (Section 1.4). The main elements of the EIA process followed are outlined below.

1.3.1 Information Gathering

Information was gathered on the natural and the socio-economic environment in the vicinity of the proposed Cambo field development, and potential sensitivities identified. Information was also gathered on the proposed operations, including the alternative options considered, and on relevant environmental legislation.

1.3.2 Commissioning Specialist Studies

Numerous environmental surveys have been conducted in Quadrant 204 and surrounding quadrants over the past 26 years, as discussed in Section 5.1.1. The most recent survey was commissioned by Ithaca Energy in 2025 which comprised geophysical and environmental surveying of the Cambo field and planned pipeline route to Rosebank.

As part of the EIA process, Ithaca Energy commissioned a fisheries intensity study (Xodus, 2019) for the area around the proposed infield Cambo field development location and previous export pipeline route which traversed the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Areas (NCMPA). A recent Vessel Traffic Survey was undertaken by Anatec (Anatec, 2025) which reviewed shipping activity in the area of the proposed development. A desktop study, undertaken by Fugro (Fugro, 2025a), reviewed the benthic conditions at the Cambo field and the revised pipeline route to Rosebank.

In addition, the following modelling studies were undertaken: drill cuttings dispersion modelling, produced water dispersion modelling and oil spill modelling (Fugro, 2025g; Fugro, 2025h; OSRL, 2020a; OSRL, 2020b).

1.3.3 Identification Potential Environmental Effects

A core element of the EIA process is the identification of all environmental impacts associated with proposed project activities which may have a 'potentially significant' effect. This process is called 'scoping'.

Ithaca Energy prepared an early consultation document which was sent to key stakeholders (statutory and non-statutory) to invite a dialogue early on in the project. This was followed up by a number of meetings during which any concerns raised were noted, so that they could be addressed fully in the ES.

In parallel to this process, Ithaca Energy undertook internal scoping exercises by means of Environmental Issues Identification (ENVID) workshops. During the ENVID workshops, all proposed development operations that may interact with the environment were listed. These activities are termed 'environmental aspects'. The source and pathway of each environmental aspect was defined, and the receptor identified. All aspects identified were then scored against the environmental receptors to determine whether their impact would require further detailed assessment and appropriate mitigation in the ES. Section 6 of this ES details all scoping activities undertaken as part of this EIA and summarises the results of the scoping process.

1.3.4 Assessment of Potentially Significant Environmental Effects

Those environmental aspects that were scoped in for detailed assessment were then assessed systematically to ensure that all potential impacts of the project were considered transparently and in the same way.

The assessment of each aspect involved describing the concern, describing and quantifying its potential effects, recognising any gaps in understanding and explaining how these are dealt with, and defining measures that have been taken to mitigate the potential effect. Section 7 of this ES describes the process used to assess potential environmental effects.

1.3.5 Development of Mitigation Measures

Identifying and assessing potential impacts and mitigating their significance is an iterative process conducted throughout the project. Mitigation measures were explored throughout the assessment process in order to eliminate or reduce the significance of the identified environmental impacts. Mitigation measures adopted are described in each of the individual impact sections (Section 8 to Section 14) and have been summarised in the Commitments Register (Appendix 2).

1.3.6 Reporting of the Outcome of the EIA Process

This ES reports the findings of the EIA process and explains how the conclusions have been reached. The ES covers:

- Non-Technical Summary;
- The reasons for the proposed Cambo field development and the nature and role of the EIA process (Section 1);
- A description of the steps being undertaken by Ithaca Energy to reduce atmospheric emissions to Net Zero (Section 2);
- A description of the option selection process for the proposed operations (Section 3);
- A description of the proposed operations (Section 4);
- A description of the environment in the vicinity of the proposed Cambo field development (Section 5);
- The methods used to identify the environmental concerns associated with the programme (Section 6);
- The methods used to assess the potential environmental effects associated with the programme (Section 7);
- A detailed assessment of each concern, including any potential in-combination, cumulative and transboundary impacts including proposed mitigation measures where appropriate (Section 8 to Section 14);
- Conclusions (Section 15);
- Several Appendices, including a summary of relevant environmental legislation, a commitments register, ENVID matrices, scoping consultee responses and production forecasts.

Formal consultation takes place following submission of the ES, which is subject to public review.

1.4 Environmental Management

All Ithaca Energy activities are carried out in accordance with Ithaca Energy's Health, Safety & Environmental (HSE) Policy Statement. Ithaca Energy's HSE Policy Statement forms part of the company's overall Management System and aligns wider regulatory compliance with Ithaca Energy's policies, standards and ways of working, in order to achieve good care of the environment. The environmental performance of any third parties contracted to support Ithaca Energy activities will be controlled under the auspices of this Policy, via appropriate interface documentation.

Ithaca Energy reviews the impact all activities may have on the environment and ensures that all environmental risks are adequately identified, controlled or mitigated to an acceptable level by way of formal assessment. Risk related decision making is carried out with competence and authority. Seasonal variation in the distribution and vulnerability of species and features, such as seabirds and marine mammals, is considered in the planning of all work programmes. Ithaca Energy has a strong understanding of required environmental provisions for UKCS licensees, including compliance with standards such as the National Marine Plan, as well as environmental consenting requirements.

1.4.1 Environmental Management During Operation of the proposed Cambo Field Development

An Installation Operator for the Cambo FPSO will be appointed in line with the Offshore Installation (Offshore Safety Directive) (Safety Case etc) Regulations 2015. Any application to appoint an Installation Operator will be subject to approval from the NSTA. As Licence Operator, Ithaca Energy must ensure that any potential operators "*have the capacity to meet the OSD [Offshore Safety Directive] requirements in relation to the particular offshore operations, duties and responsibilities relevant to the appointments, and must take all reasonable steps to ensure that the appointed operators satisfy those requirements*" (BEIS/HSE, Undated). Following a successful application, Ithaca SP E&P Limited was appointed as well operator for all operations, concerning the existing wells and all future wells at Cambo, in April 2025.

Ithaca Energy must ensure that any third parties appointed to work on Ithaca Energy's behalf fulfil requirements as detailed in the Offshore Installations (Offshore Safety Directive (OSD)) (Safety Case etc) Regulations 2015[1]. Environmental management is inextricably linked to requirements of the OSD and is often referred to in the context of the operators safety and environmental management system (SEMS).

With specific reference to environmental management, operatorship appointments are subject to evidence of the following environmental provisions being in place:

- Environmental Policies;
- Understanding of statutory environmental provisions and roles and responsibilities in relation to environmental management; and

[1] These Regulations implement the requirements of the Offshore Safety Directive (OSD) (Directive 2013/30/EU);

- Have an environmental management system or a commitment to have such a system in place prior to undertaking offshore activities. All Well and Installation Operators are required to have an Environmental Management System (EMS) that fulfils the requirements of BEIS EMS Guidance (BEIS, 2014) and that of OSPAR Recommendation 2003/5[2].

As part of this assurance process, third parties will need to demonstrate to Ithaca Energy:

- That any operational activity will be conducted in accordance with the company's (i.e. Contractor's) Environmental Policy;
- That an EMS certified (and verified by an external verification company) to the International Standard for Environmental Management Systems, ISO14001:2015, is in place and implemented;
- That they have extensive knowledge of UKCS environmental consenting requirements; and
- A history of compliance with environmental legislation.

Third parties will also be subject to audit by Ithaca Energy. Key areas of consideration during the audit will include:

- Environmental policies and overall management arrangements, including the status of EMS certification where applicable;
- Mechanisms for the identification of environmental issues and legislation and the undertaking of risk assessments;
- Arrangements for staff training and competence assurance;
- 'Shipboard' oil pollution and emergency arrangements, including Safety Case;
- Hazardous substance handling and storage procedures;
- Arrangements for legal compliance evaluation e.g. drainage discharge monitoring;
- Waste management practices and procedures, including associated onshore issues;
- Controls on key emissions to water and air; and
- Mechanisms for the achievement of continuous improvement in performance.

Specific environmental management activities relating to operational activities will be taken forward in an Environmental Management Plan (EMP) which will incorporate the mitigation, control and monitoring measures identified in this environmental statement as well as the responsibilities for implementation.

[2] OSPAR Recommendation 2003/5 promotes the use and implementation of Environmental Management Systems (EMS) by the Offshore Industry.

2. Net Zero Action Plan

This section discusses Ithaca Energy's greenhouse gas (GHG) emissions strategy, policy and targets and how these are embedded in the Company's management systems.

2.1 Legislative and Regulatory Framework

The United Kingdom's Climate Change Act 2008 sets a legal requirement to achieve a 100 % reduction in GHG emissions by 2050 relative to 1990 levels. In Scotland, The Climate Change (Scotland) Act 2009, as amended by The Climate Change (Emissions Reductions Targets) (Scotland) Act 2019, sets targets to reduce Scotland's emissions of all GHG to net-zero by 2045.

These targets are mirrored by sector-specific policy commitments, such as the North Sea Transition Deal (NSTD) and the British Energy Security Strategy, which support oil and gas production while mandating emissions reductions and decarbonisation through measures such as offshore electrification.

Ithaca Energy's approach to reducing emissions is guided by the Oil and Gas Authority (OGA) Strategy (now administered by the North Sea Transition Authority (NSTA)), which replaced the earlier Maximising Economic Recovery (MER) UK Strategy. The updated OGA Strategy retains the focus on maximising the economic recovery of petroleum while integrating obligations to reduce GHG emissions as far as reasonably possible. Licensees must take reasonable steps to limit emissions from flaring, venting, and power generation, and support carbon capture and storage (CCS) initiatives. Deployment of emerging and existing technologies is expected to be optimised for emissions control.

The NSTA has also produced a series of documents, referred to as Stewardship Expectations. These expectations promote responsible emissions monitoring, reporting, and reduction initiatives and reinforce the industry's role in achieving Net Zero by 2050. A total of 12 Stewardship Expectations have been produced to date. Stewardship Expectation 11 'Net Zero' sets out typical examples of actions that could be undertaken to reduce emissions during all stages of the project lifecycle. Developments which are considered to align with the aims of Stewardship Expectation 11 will contribute to meeting the Net Zero target.

In addition, the Zero Routine Flaring (ZRF) Initiative, introduced by the World Bank in 2015, commits government and industry to end routine flaring at production sites no later than 2030 and to ensure that new developments are designed without the need for routine flaring of any associated gas which may be produced from the field. Where routine flaring occurs at existing fields, operators should seek to implement solutions to eliminate flaring as soon as possible and no later than 2030. The ZRF Initiative relates to routine flaring operations and does not encapsulate flaring for safety reasons or non-routine flaring. However, these types of flaring operations should be minimised as far as possible. Under this initiative, venting is not an acceptable substitute for flaring.

2.2 Emissions Baseline and Performance

Ithaca Energy's emissions baseline[1] is established through data recorded in line with the GHG Protocol[2] and used for regulatory submissions including those for the Emissions Trading Scheme (ETS) and the Environmental and Emissions Monitoring System (EEMS), covering direct emissions from production operations. Aligned with the NSTA targets, Ithaca Energy's baseline year for performance tracking is 2018.

From 2018 to 2024, Ithaca Energy has achieved a 21 % reduction in GHG emissions compared to the baseline year. This was driven by:

- Operational efficiencies;
- Reduction in flaring and venting;
- Asset divestment and decommissioning;
- Routine equipment upgrades and maintenance improvements; and
- Execution of projects as per the Company's Emissions Reduction Action Plan (ERAP) (Section 2.6).

In addition, gross operated emissions intensity reduced from 25 kg CO_2e/boe in 2023 to 23.9 kgCO_2e/boe in 2024 on a Scope 1 and 2 basis, and methane intensity reduced from 0.2 % to 0.1 % over the same period. Ithaca Energy is committed to the continual year-on-year emissions intensity reduction and maintaining lower than basin average intensities.

2.3 Emissions Reporting and Governance

Accurate recording and reporting of emissions is central to Ithaca Energy's environmental governance framework. The company reports atmospheric emissions under multiple schemes:

- UK Emissions Trading Scheme (UK ETS) — for installations regulated under emissions permits;
- EEMS — annual environmental reporting;
- Energy Savings Opportunity Scheme (ESOS) and Streamlined Energy and Carbon Reporting (SECR) — corporate-level reporting requirements;
- Carbon Disclosure Project (CDP) and Task Force on Climate-Related Financial Disclosures (TCFD) submissions — for transparency to investors and regulators; and
- Oil and Gas Methane Partnership (OGMP) 2.0 – for improving the monitoring and verification of the Company's methane emissions data, so that it may identify areas for further methane reduction and mitigation. In October 2025 Ithaca Energy was awarded a 'Gold Standard Pathway' certification from OGMP 2.0 in recognition of the efforts made in improving methane management across the Company's operations.

[1] On a Scope 1 basis only
[2] The GHG Protocol (https://ghgprotocol.org/) provides standards, guidance, tools and training for business and government to measure and manage climate-warming emissions.

Responsibility for emissions management lies with Ithaca Energy's Environmental & Energy Transition Manager, supported by the wider HSE (Health, Safety and Environment) Team, while Board-level accountability is maintained through quarterly HSE performance reviews.

2.4 Environmental Management System

Ithaca Energy takes a proactive approach to managing environmental aspects by systematically identifying, monitoring, and reducing environmental impact. The Company regularly reviews its operations, sets measurable environmental objectives, and engages employees in environmental awareness and initiatives. Through this structured approach, Ithaca Energy aims to minimize waste, reduce atmospheric emissions and promote environmental stewardship.

All Ithaca Energy operations and projects have the potential to impact on the environment and they are all subject to strict environmental regulatory controls. These require Ithaca Energy to prepare and submit regulatory applications to gain approval before activities commence. Ithaca Energy constantly monitors operational activities and reports ongoing emissions, discharges and waste streams to ensure regulatory compliance and to ensure that there is no significant impact on the environment. In the event of an unplanned release/spill to sea, or a non-compliance with regulatory requirements, the relevant regulatory authorities would be notified and immediate actions taken to respond to any threat of, or actual, pollution. Investigations of incidents are conducted to gain any learnings or actions to prevent recurrence.

Ithaca Energy's Environmental Management System (EMS) follows the Plan-Do-Check-Act (PDCA) cycle, elements of which are embedded in the Company's day-to-day activities. Increasing awareness of environmental compliance, ensuring that the environmental considerations are embedded in everything that Ithaca Energy does and ensuring processes and control measures are robust are just some examples of how the Company works to ensure continual improvement.

Ithaca Energy takes pride in:

- Having a relentless focus on high performance;
- Continuously reducing the health, safety and environmental impact of its operations;
- Developing an engaged workforce, in an inclusive, dynamic workplace; and
- Striving for efficiency and simplicity in all that is done.

Ithaca Energy's leadership team have set ambitious company targets and asset specific emissions reduction Key Performance Indicators (KPIs). Performance is reviewed by leadership on a monthly basis and communicated to Company employees at regular intervals.

In addition, the Ithaca Energy HSE Team has annual integrated objectives and an improvement plan which outline key elements for measuring success in progressing towards climate targets. This plan is endorsed by the Company's Executive Leadership Team and the Board.

Using the EMS process, Ithaca Energy regularly assesses emissions abatement opportunities. Using these processes, Ithaca Energy has overseen a net reduction in flaring and venting emissions across all assets since 2018. As responsible joint venture (JV) partners, Ithaca Energy also encourage and support large emissions abatement projects, such as electrification, on non-operated assets.

2.5 Net Zero Targets and Objectives

As stated above, Ithaca Energy's emission reduction targets are aligned with the NSTD target, with an interim target of a 50 % reduction in operated emissions by 2030 (relative to the 2018 baseline). These targets are for Scope 1 and 2 GHG emissions, on a Net Equity basis.

Ithaca Energy's roadmap includes annual asset emissions targets, operational improvement initiatives, and decarbonisation projects aligned with industry best practice.

Interim milestones include:

- Completing planned and approved emissions reduction projects;
- Continual evolvement of the ERAP, including completing ongoing new studies;
- Deploying methane detection technologies;
- Developing a supplier engagement program for emissions assessment and reduction; and
- Collaborating with industry on low-carbon project collaborations.

2.6 Emissions Reduction Action Plans

Ithaca Energy's emissions reduction initiatives span operational controls, infrastructure modifications, and technology adoption.

2.6.1 Ithaca Energy's Emissions Reduction Action Plan (ERAP)

Ithaca Energy's ERAP demonstrates its commitment to meeting NSTD objectives to reduce emissions from the sector in line with the UK's Net Zero targets. The ERAP is aligned with Stewardship Expectation 11 (SE-11) of the NSTA and covers all Ithaca Energy operated assets, with topsides equipment.

The ERAP is reviewed and updated to take account of work completed each year and to review and agree opportunities to reduce emissions. ERAP projects under consideration and which are at varying stages of construction / implementation include:

- Projects which allow zero routine flaring, including flare gas recovery;
- Cargo tank vent vapour minimisation and recovery;
- Replacement of all hydrocarbon blanket gas with nitrogen;
- Right size equipment to fit its duty and avoid waste;
- Control logic improvements to reduce likelihood of trips and flaring events; and
- Alternative fuels to replace diesel used offshore.

A database (also referred to as the 'opportunity hopper') of all potential emissions reduction opportunities is managed on behalf of the assets by the Environment Team. The database

comprises opportunities in all stages of development, from ideas and areas to explore, to projects undertaking feasibility studies, right through to already completed scopes. The database is updated frequently as new ideas and added information is made available. It is periodically reviewed by all levels of the organisation up to the executive leadership team.

Emissions benefits are determined based upon their relative performance to Ithaca Energy's baseline year of 2018.

2.6.2 Low Carbon Power

Ithaca Energy recognises the need to reduce as far as reasonable GHG emissions from its assets, including the proposed Cambo field development.

Following an assessment of decarbonisation options, electrification of energy demand from a low carbon source has been identified as offering the most significant opportunity to reduce the GHG emissions footprint of the Cambo field development. There are, however, a number of uncertainties with regard to timing of the availability of low carbon power to the field, some of which are beyond the control of Ithaca Energy.

Electrification of the Cambo asset is contingent upon these primary requirements:

- Availability of a reliable source of power in Shetland capable of meeting the required export capacity.
- Availability of technology of sufficient maturity and with proven performance to enable safe and reliable power transmission from the onshore substation to the offshore facility located in 1,100 m water depth.

On this basis, the initial power and heat generation philosophy for the Cambo project will be to utilise gas turbine-driven power generators with waste heat recovery.

Provisions will be made within the facilities design such that the Cambo FPSO will be electrification-ready on arrival in the field. This will facilitate and simplify future electrification of the Cambo asset (with the FPSO able to remain on-station) if a technically and economically viable low carbon power source can be made available. The hull / turret design and process facilities layout shall include provision for future power systems installation, plus electrical and utilities infrastructure for receipt and distribution of power and heat to users.

The electrification of Cambo requires technology development in particular areas, most notably the dynamic power cable; deepwater subsea transformer (if required) and connector systems; transmission losses over the step-out distance and reactor on FPSO.

Ithaca Energy are committed to actively work the challenges and uncertainties to electrification. Recognising opportunities for collaboration and collective effort in potential delivery of a viable low carbon power solution benefitting from economies of scale in terms of shared cost and risk with other asset operators in the West of Shetland area.

Ithaca Energy and the previous Cambo joint venture partners assisted in establishing the West of Shetland electrification (WoSE) workgroup to explore opportunities, and to address the challenges of electrification through collaboration with other West of Shetland upstream oil and gas Operators and stakeholders.

Ithaca Energy's participation in the WoSE workgroup helped inform the design provisions to be made to the FPSO to retain optionality for potential future electrification as respective development plans mature, and this will continue to ensure that the proposed Cambo field development can take advantage of opportunities identified to deliver a technically and economically viable electrification solution.

2.6.3 Alternative Fuels

Electrical power generation on all Ithaca Energy operated assets is predominately from fuel gas with the exception of the Captain Floating Production Storage and Offloading (FPSO) which is powered from imported diesel and some low-pressure fuel gas. Ithaca Energy has been investigating other low carbon power solutions beyond major electrification projects. Lower carbon intensity fuels, include gas hydrotreated vegetable oil (HVO).

While replacement of diesel as a fuel source could result in important CO_2e reductions, alternative fuels present significant challenges such as safety implications, availability of supply and delivery logistics, making them non-viable at present. However, as a key member of the Offshore Energies United Kingdom (OEUK) sustainable fuels group, Ithaca Energy continues to regularly review alternative fuels in the UKCS.

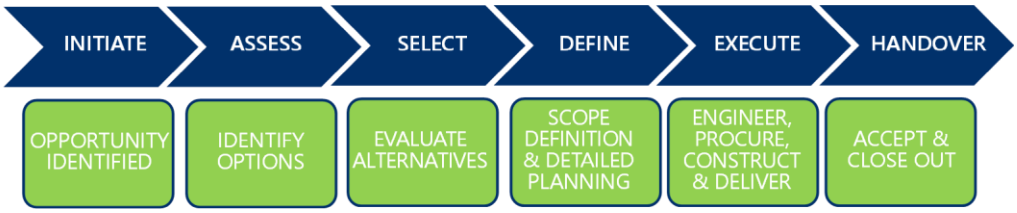
2.7 Cambo Field Development

The Cambo field development will be included in any future updates to the ERAP. For the purpose of assessment in this ES, the estimated emissions from the Cambo field development, including downstream Scope 3 emissions, during drilling and construction, as well as an assessment of the potential impacts from atmospheric emissions are assessed in Section 9, Atmospheric Emissions.

3. Option Selection

3.1 Introduction

This section of the Environmental Statement (ES) describes the main alternatives considered for the proposed Cambo field development during the early Assess and Select (Concept and Pre-FEED) and Define (Front End Engineering and Design, FEED) stages of the Ithaca Energy Stage Gate Process (ISGP). Figure 3.1 outlines the six stages (Initiate, Assess, Select, Define, Execute and Handover) of the ISGP.



Gate Decision	The opportunity identified. This opportunity is worth pursuing and fits the portofolio.	Commercially viable. There is at least one concept that will work in most outcomes.	We have selected the best concept and are ready to start the project definition.	Project definition is ready and the project is attractive enough to take sanction.	Construction and pre-commissioning are complete. It is safe to energise and/or introduce hydrocarbons.	Project is delivered and reached steady-state. We have collected the Lessons Learned. Operations can accept the project.
Direction from Owner	Establish project 'frame' (purpose, perspective and scope) and check against the portfolio for strategic fit.	Assess the range of feasible options and the range of possible outcomes. Identify scope and reduce uncertainty.	Make all strategic and conceptual decisions.	Draw up the specification(s) for the project and prepare for project sanction. Obtain firm quotations.	Deliver the promise made during sanction safely and responsibly.	Establish stable operations, check against the Business Case and collect Lessons Learned. Disband the Team.
Main Activities	Opportunity Framing. Establishing the Business Case.	Choosing a range of options and outcomes. Demonstrating feasibility.	Selecting the best alternative. Planning the Field Development and completing the design basis.	Establishing the Basis for Design and the Project Specification(s) (FEED).	Awarding to selected bidders. Managing detail design, procurement, construction and pre-commissioning	Assisting with commissioning and establishing stable operation. Collecting Lessons Learned and disbanding the Team.

Figure 3.1: Ithaca Energy stage gate process

Having a common understanding and alignment amongst project teams, management, joint venture partners and other key stakeholders on strategic project issues is key to ensure that the field development opportunity is appropriately framed. This ensures that decision criteria for the selection of alternatives are agreed and established early in the project life cycle i.e. during the Assess and Select Phases.

3.1.1 Legislative Requirements

The option selection process forms an integral part of the overall Environmental Impact Assessment (EIA) process and, in line with Schedule 6 of The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 (as amended), should provide *"A description of the reasonable alternatives (for example in terms of*

project design, technology, location, size and scale) studied by the developer and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment and including a comparison of environmental effects."

The guidance notes published by the Department for Business, Energy and Industrial Strategy (BEIS)[1] and Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) in support of the above EIA Regulations (Current version: July 2021, Revision 3, (BEIS, 2021)), provide further guidance on this topic and stipulate that the ES should "*describe the main alternatives to the proposed project that have been considered, and clearly describe the advantages and disadvantages of each option and the associated environmental implications. The main reasons for selection of the preferred option should be summarised, taking particular account of the environmental issues. Other factors influencing the final choice should also be recorded, e.g., feasibility including technical constraints and cost effective issues relating to each option. If a formal option appraisal system has been used, it should be described, and the relevant decision factors identified.*

Where appropriate, consideration should always be given to alternative sites (including pipeline routes), alternative timing, alternative construction methods, alternative plant and equipment and alternative operating practices. Wherever possible, OPRED would always encourage the use of existing infrastructure, and if there is existing infrastructure available but its use is not the selected option then a robust justification should be provided. The consideration of alternatives may also be relevant for the drilling of a well and details of the decision-making process should be included, e.g., alternative sites, alternative rig types, alternative timing, slim hole, horizontal or extended reach technologies, alternative drilling muds and alternative cuttings treatment and disposal options.

Where final option selection has not been made before the submission of the ES, it is acceptable for more than one option to be presented in the assessment. However, sufficient detail must be provided to enable a full assessment of each option. OPRED may then provide its agreement to the grant of consent for all the options, or where applicable for a specific option, if other options are determined to have a significant effect."

3.1.2 Planning the Proposed Cambo Field Development - Background

In 2022, Ithaca Energy acquired Siccar Point Energy (SPE) and the licence rights to the Cambo field. Following completion of a 2015 work programme, the licence operator at the time concluded that a standalone Early Production System (EPS) approach to the Cambo field development was preferred to mitigate subsurface risk and allow the appraisal of the full field and other opportunities to follow. EPS planning was underway when SPE became the licence operator of the Cambo field.

In order to comprehensively test the conclusions drawn by previous licence operators, Ithaca Energy revisited the development options for the Cambo field to identify and re-evaluate all

[1] The energy policy responsibilities of the Department for Business, Energy, and Industrial Strategy (BEIS) were transferred to the Department for Energy Security and Net Zero (DESNZ) in February 2023

credible concepts and approaches to the development. Initial work focussed on subsurface studies and the need for further appraisal to reduce remaining subsurface uncertainty and inform development concept selection.

In 2018, a further appraisal well (204/10a-5) was drilled. The main objective of this well was to perform a well test to obtain information on well deliverability and connected volumes, to de-risk concerns around reservoir connectivity. The well encountered oil-bearing Hildasay H50/H40/H30 sands that were cored. The subsequent horizontal side-track (204/10a-5Y) was completed and tested in the H50 reservoir unit. The well flowed naturally for 10 days at rates of circa 795 m^3/day (5,000 bpd) of dry oil, recovering approximately 7,472.4 m^3 (47,000 bbls) oil over the test period. All test objectives were met, and a high-quality data set acquired. Analysis established reservoir continuity and confirmed that the Hildasay reservoir at Cambo comprises excellent quality sands.

Recent reviews of the previously proposed development have identified further opportunities to optimise the design of the Cambo field development further. These are described in detail in Section 3.2 onwards.

3.1.3 Option Screening and Selection Process

Having a common understanding and alignment amongst project teams, management, joint venture partners, and other key stakeholders on strategic project issues is key to ensuring that the field development opportunity is appropriately framed, and key value drivers and critical success factors are established. This ensures that decision criteria for the selection of alternatives are agreed and established early in the project life cycle i.e. Assess and Select Phases (see Figure 3.1).

3.1.4 Project Value Drivers and Decision Criteria

There are a number of areas that have potential to add value to the project, including schedule, overall development cost, project scope and facilities design and build quality. These so-called 'Value Drivers' provide focus for the project team and establish the basis for prioritising activities and developing optimal solutions. Making decisions that offer the best overall outcome and ensure environmental and economic sustainability are essential for the project. As such, Ithaca Energy developed decision criteria and identified critical success factors (those issues to consider and manage to ensure a successful project outcome) to aid decision-making (Table 3.1).

Table 3.1: Decision criteria and project goals and value drivers for the Cambo field development

Decision Criteria	Project Goals	Risks/Opportunities to Consider
Health, safety and environment	■ Industry-leading HSE practices; ■ Minimising environmental impacts.	■ Scale and likelihood of hazards/management options; ■ Inherently safe design; ■ Environmental impact; net zero obligations and opportunities.
Cost and value	■ Economically attractive solution; ■ Delivery of project to schedule and budget promise.	■ Cost and schedule estimates/risks, opportunities and uncertainties; ■ Maximising Economic Recovery Strategy for the UK (MER UK); ■ Reserves recovery; ■ Balance against capital expenditure (CAPEX) goals.
Technical	■ Industry leading outturn performance in design; ■ Improved understanding of Cambo reservoir; ■ Maximising economic hydrocarbon recovery.	■ Design simplicity; ■ Robust front-end loading ■ Technology stretch; ■ Track record in deep water, harsh environment; ■ Flexibility; ■ Subsurface uncertainty.
Deliverability	■ Industry-leading project outturn performance.	■ Acceptability to regulators (NSTA, DESNZ, OPRED, HSE) and other stakeholders; ■ Alignment with NSTA strategies (MER UK and net zero); ■ Partner alignment; ■ Deliverability of sanctionable Field Development Plan (FDP); ■ Market conditions/schedule risk; ■ Execution risk; weather windows.
Operability	■ Competitive outturn performance in operation; ■ Delivery of project functional objectives.	■ Operations & Maintenance (O&M) philosophies; ■ Training/sparing; ■ Production and operating efficiency; ■ Human factors.

The list of decision criteria included in Table 3.1 is not exhaustive. A crucial element within the criteria and the decision-making process has been consideration of potential environmental impact and the environmental sensitivities within the area of the Cambo field development.

3.1.5 Other Factors Influencing Concept Selection

In addition to the value drivers mentioned above, there are a number of other critical success factors that have influenced concept selection for the proposed Cambo field development. These factors are supporting objectives or activities that will support the value drivers – if managed well, these will assist the project in achieving its goals, but conversely if poorly managed will erode value; the key factors are illustrated in Figure 3.2.

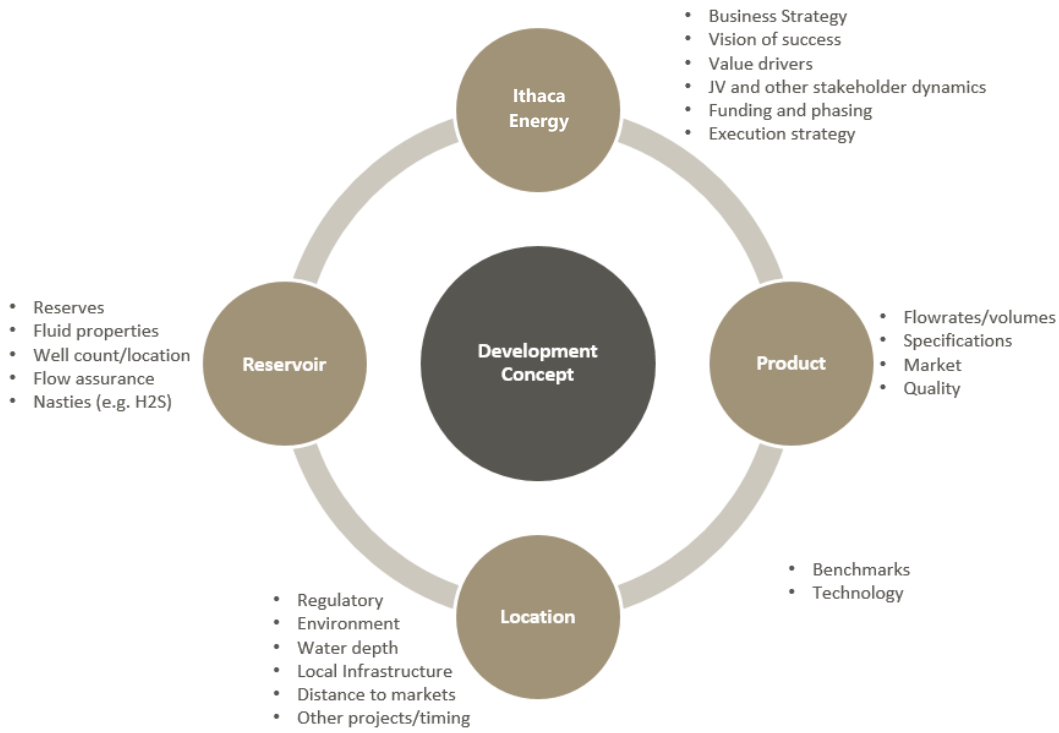


Figure 3.2: Key factors influencing concept selection

3.2 Development Justification

The Department for Energy Security and Net Zero (DESNZ) is responsible for setting out the overall energy policy for the United Kingdom. The most recent energy policy paper 'Powering Up Britain' (DESNZ, 2023a) and its associated Energy Security Plan (DESNZ, 2023b) were published in March 2023. Both policy papers refer to the requirement for "*maximising the vital production of UK oil and gas as the North Sea basin declines*".

Similarly, the revised Oil and Gas Authority (OGA)[2] Strategy published on 11 February 2021, reiterates in its central obligation that "*Relevant persons must, in the exercise of their relevant activities, take the steps necessary to:*

a) secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters; and, in doing so,

b) *take appropriate steps to assist the Secretary of State in meeting the net zero target, including by reducing as far as reasonable in the circumstances greenhouse gas emissions from sources such as flaring and venting and power generation, and supporting carbon capture and storage projects.*"

[2] The Oil and Gas Authority (OGA) changed its name to become the North Sea Transition Authority (NSTA) on 21 March 2022.

In addition, the supporting obligations for developments state that "*Relevant persons must plan, commission and construct infrastructure in a way that meets the optimum configuration for maximising the value of economically recoverable petroleum that can be recovered from the region in which the infrastructure is to be located.*"

Consequently, the development of the Cambo field is in line with the objectives set out in these Government policy and strategy documents.

Whilst not developing the Cambo field (i.e. the so-called 'Do nothing' scenario) would avoid any potential for environmental impact, it would also prevent the extraction of a viable local hydrocarbon resource that could contribute to the UK's energy security requirements and would also not provide any economic benefits to Ithaca Energy and the UK.

Therefore, Ithaca Energy would like to take this opportunity to develop the Cambo field in order to maximise its economic return whilst taking due consideration of and by minimising its environmental impacts in doing so (Figure 3.3).

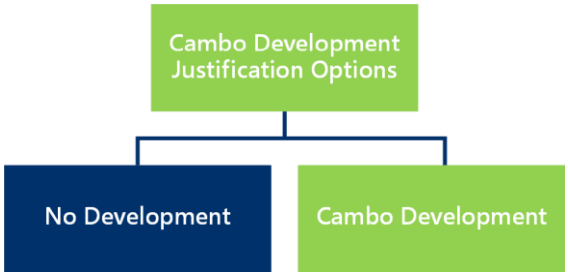


Figure 3.3: Option decision tree for Cambo field development justification

3.2.1 Critical Success Factors and Project Objectives

Ithaca Energy is committed to producing oil and gas responsibly. As it navigates the energy transition it recognises that oil and gas will continue to play an important part of the long-term energy mix to meet the UK's energy demands. Ithaca Energy's Environmental Management process identifies and addresses the environmental impact of all aspects of its operations, driving continuous improvement in environmental performance and reducing its environmental impact. To put this into practice, Ithaca Energy has adopted a number of Critical Success Factors and Project Objectives in the project decision making process, as outlined in Figure 3.4.

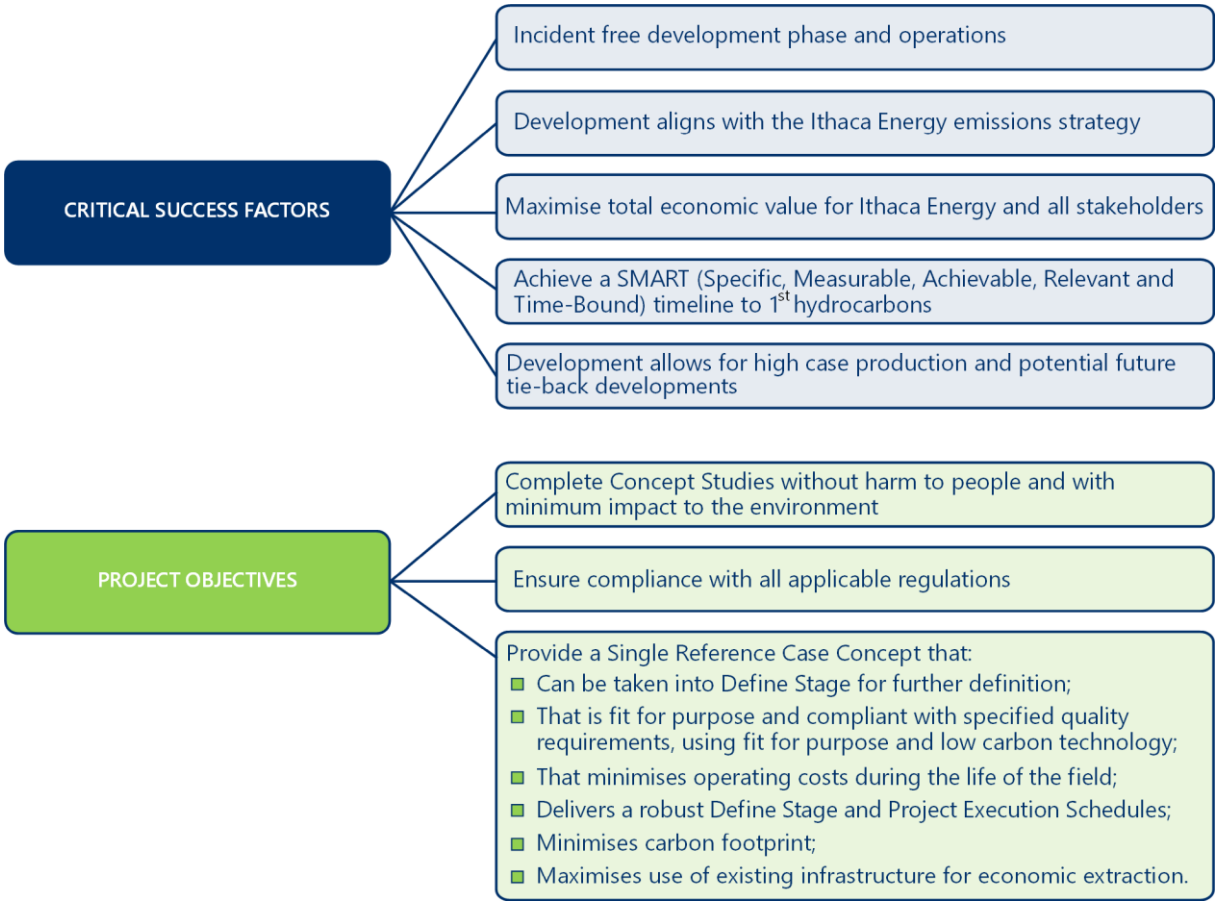


Figure 3.4: Critical success factors and project objectives

3.3 Option Identification and Selection

The following sections detail the basic development concepts and development component sub-options considered for the Cambo field development.

Flow diagrams for each of the key decisions and elements of the project have been provided for ease of reference. Green boxes indicate which decisions have been taken. Shaded green / blue boxes, such as Section 3.3.2.4, highlight where a final decision is still to be made.

3.3.1 Field Development Concept

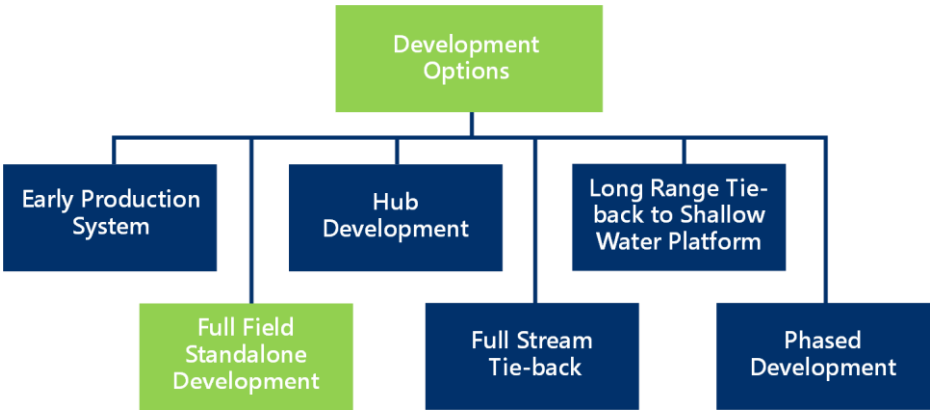


Figure 3.5: Option decision tree for Cambo field development concept

This section summarises the range of highest-level field development concept options considered by previous operators and subsequently re-evaluated by Ithaca Energy.

3.3.1.1 Option 1: Full Field Standalone Development

This option is based on a deepwater floating production, storage and offloading host facility at the Cambo field in approximately 1,073 m to 1,105 m water depth. The host facility would process only the Cambo well stream fluids with oil and gas exported. Options considered for the floating production host facility included:

- Floating production, storage and offloading (FPSO);
- Semi-submersible platform;
- Tension-leg platform (TLP);
- Single point anchor reservoir (SPAR) platform.

3.3.1.2 Option 2: Hub Development

This option would be similar to the full field development standalone option (Section 3.3.1.1) with the addition of the subsea tie-backs to a host facility at Cambo. Host topsides with additional inlet reception, gas processing and compression, hydrate management (MEG injection, reception and reclamation) facilities to accommodate tie-back fluids processing.

3.3.1.3 Option 3: Full Stream Tie Back

This option involves the co-development of the Cambo field as a subsea tie-back to an existing host facility e.g. the proposed Rosebank development which is located approximately 23 km northeast of the Cambo field. Subsea multiphase (combined oil, gas and water) pumping to transfer the Cambo wellstream fluids to the Rosebank FPSO. All processing and export functions would be carried out on the Rosebank FPSO using common facilities with increased capacity. Power, chemicals and control provided by the Rosebank FPSO to the Cambo field.

3.3.1.4 Option 4: Long Range Tie Back to Shallow Water Platform

Similar to the Cambo Hub (Section 3.3.1.2), premised on co-development of the Cambo field with other regional resources. The host in this case is located approximately 80 km southeast of Cambo in shallow water, enabling the use of a fixed substructure. This development concept requires subsea separation and / or pumping of the liquids to enable fluids to flow to the shallow water location with substantial power transfer from the host.

3.3.1.5 Option 5: Standalone Early Production System

Similar to the Cambo standalone concept with variation on scope, commitment and timing of distinct development phases.

3.3.1.6 Option 6: Phased Field Development

Similar to the Cambo standalone concept with variation on scope, commitment and timing of distinct development phases. Certain aspects of the project would be developed initially with additional wells and drill centres drilled and / or installed at a later date.

3.3.1.7 Field Development Concept Summary

Due to the water depth at the Cambo field (approximately 1,073 m to 1,105 m), areal extent of the field and the low well density / shallow nature of the Cambo reservoir (circa 2,400 m True Vertical Depth Subsea (TVDSS)), all concepts were centred on a wet tree / subsea production system (SPS) with surface processing facilities.

The conclusions from the evaluation showed that while all options were technically feasible, a full field standalone development was preferred. The key factors supporting the decision were:

- Improved confidence/understanding of the Cambo reservoir, deliverability and recoverable resources through the successful drilling and test of the Cambo 204/10a-5Y well;
- More substantive incorporation of features to reduce environmental impact; and
- Increased confidence in the Cambo reservoir supporting a full field development from the outset.

Table 3.2 summarises the rationale for rejection of the alternatives based on the project decision criteria outlined in Section 3.3.1.

Table 3.2: Rationale summary for rejection of field development concept alternatives

Rejected Option	Positive Aspects	Rationale for Rejection
Option 2 Hub development	■ Infrastructure enabler to unlock development of other discoveries and prospects.	■ Uncertainty of probability/timing of development of nearby discoveries and prospects; ■ High initial CAPEX and uncertain timeline for development; ■ Flow assurance associated with long tie-back of gas resources to Cambo location.
Option 3 Full stream tie-back (to existing host)	■ Low capital expenditure and schedule opportunities. ■ Inherent safe design. ■ Efficient use of existing infrastructure; reduced environmental footprint.	■ No local infrastructure; lack of availability of a suitable existing host to accommodate Cambo; ■ Uncertainty over timing of other prospective area developments (e.g. Rosebank); ■ Flow assurance (wax and hydrate management) associated with Cambo fluids and long tie-back to existing facilities.
Option 4 Long range tie-back to shallow water platform	■ Technical risk associated with floating system in harsh, deep water environment removed.	■ No suitable existing shallow water host platforms nearby; ■ High CAPEX for new-build shallow water host option; ■ Flow assurance (wax and hydrate management) associated with Cambo fluids and long tie-back to existing facilities.

Rejected Option	Positive Aspects	Rationale for Rejection
Option 5 Standalone Early Production System	■ Lowest cost exposure in event of poor reservoir outcome. ■ Schedule opportunity through redeployment of existing assets with modest conversion scope.	■ Greater confidence in Cambo reservoir supports more substantial first phase development; ■ Lack of suitable host options available for an Early Production System at acceptable technical risk/CAPEX level; ■ Poor environmental performance – Early Production System would not support gas disposal options other than routine flaring.
Option 6 Phased Development	■ Low cost exposure in the event that the development does not reach anticipated production levels ■ Smaller initial environmental footprint	■ Greater confidence in Cambo reservoir supports more substantial first phase development;

✓ **Development Concept Decision:** Full field standalone development

3.3.2 Drilling/Wells

3.3.2.1 Mobile Offshore Drilling Unit (MODU) Type

The proposed Cambo host facility will not have any drilling capability and therefore a MODU is required to drill the production, water injector and potential optional appraisal wells. Figure 3.6 shows the various MODU types that have been considered to drill the Cambo wells.

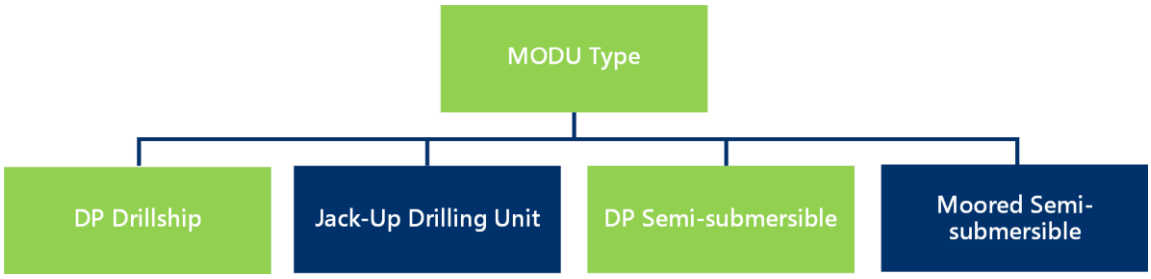


Figure 3.6: Option decision tree for Cambo MODU selection

When drilling for oil and gas three types of MODU can be used, namely:

- A jack-up drilling unit;
- A moored or dynamically positioned (DP) semi-submersible drilling unit;
- A DP drillship drilling unit.

The key criteria considered when reviewing the type of MODU to use drill the Cambo wells included:

- Deepwater capability;
- Favourable motion characteristics under harsh weather conditions west of Shetland and likely weather uptime; and
- Operational efficiency in subsea completions and subsea tree installations.

Due to the water depth, DP MODUs are considered to represent the only feasible option for drilling operations at the Cambo field. Jack-up drilling rigs can only operate in water depths up to approximately 120 m and therefore the depths at the Cambo field are not suitable for this type of drilling unit. Similarly, the use of a DP MODU at these water depths presents advantages with respect to positional accuracy and increased safety levels due to the elimination of risk associated with anchor handling operations.

Furthermore, use of a DP MODU, as opposed to wire / chain moored MODU, is advantageous as it can be positioned more readily between the various drilling locations at the Cambo field. This reduces the potential for impacts on the seabed from anchors which would require multiple deployments across the site. The nature of the drilling programme for Cambo is such that MODU movements will be frequent therefore multiple anchor moves would be required.

A review of the two options, drillship and semi-submersible, noted that drillships offer favourable mobility, transit speed and deck load capacity whilst the semi-submersible hull design possess greater stability and improved vessel motion response to metocean conditions at the Cambo field, resulting in higher uptime or reduced risk of frequent disconnection. It was concluded that both MODU types would be suitable for use in the Cambo field development.

✓ **MODU Type and Mooring System Decision:** DP drillship or DP Semi-sub

3.3.2.2 Well Type

Figure 3.7 shows the options selection process for the various well types considered for the Cambo field development.

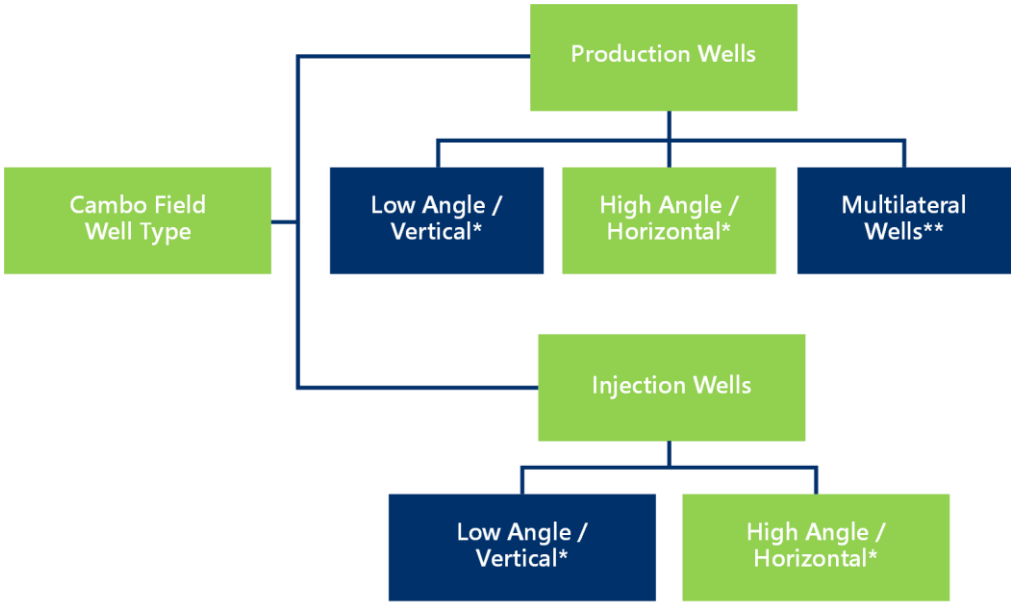


Figure 3.7: Option decision tree for Cambo well type

Production Wells

Three well types were considered for the oil producers:

1. Low angle;
2. High angle/horizontal; and
3. Multilateral wells, which would have two or more producing bores.

The proposed field development well construction objective is to achieve maximum reservoir recovery from the simplest well design.

One advantage of multilateral wells (i.e. those with multiple branches from the same well bore) is that they can produce from multiple reservoir sections within the same well, which might reduce the required well count and the construction costs of the upper hole sections. However, the multilateral design itself introduces extra complications and risks for a successful completion, can compromise well locations and can reduce production rates.

Multilateral wells are not expected to be cost efficient at the Cambo field and their use has been rejected for this development.

High angle or horizontal producers are needed to achieve attractive production rates. Given the shallow depth and stratigraphy of the reservoir, long high angle horizontal reservoir sections maximise recovery and limit the required well count (thereby minimising potential environmental impacts of drilling and production operations e.g. drill cuttings disposal, energy and resource use etc.).

The horizontal 2018 appraisal well proved the feasibility of drilling such wells in the Hildasay sands.

✓ **Production Well Type Decision:** Dedicated, High Angle Wells

Injection Wells

The extent of any aquifer is uncertain and the Cambo field development will be developed using peripheral water injection to provide pressure support and to sweep oil to the production wells. Two water injectors will be available at first oil with an additional two water injectors included in development plans should they be needed to effectively develop the field.

The initial injection wells will be dedicated to individual reservoir units, with decisions on future injection well type to be determined based on observed well performance. This approach ensures injection into each reservoir unit and offers improved reservoir monitoring / data acquisition.

The wells will be high angle single bore wells in order to maximise injectivity and prevent the risk of loss of containment (out of zone injection).

✓ **Injection Well Type Decision:** Dedicated, High Angle Wells

3.3.2.3 Well Construction

Figure 3.8 shows the two well construction alternatives that were considered for delivery of the wells:

1. Batch drilling and completion - drill the upper sections of several wells first, before re-entering each at later dates to drill and complete the remaining lower sections; and
2. Sequential drilling - drill and complete one well at a time.

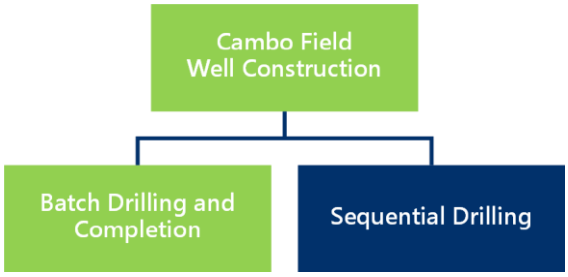


Figure 3.8: Option decision tree for Cambo well construction

The option selected was batch drilling and completion. This decision was primarily driven by the efficiencies gained through batch operations and the benefit it provides in scheduling operations during the winter months, which see particularly harsh weather conditions at the Cambo area. In addition, the efficiencies gained in the drilling schedule will also minimise the overall amount of atmospheric emissions generated.

The top-hole conductor section of the well will either be drilled conventionally with a 36" × 30" conductor then cemented in place or this will be replaced with a suction piled CAN-ductor with an integrated wellhead housing and conductor extension joint.

The well sequence will be optimised and Blowout Preventer (BOP) Hopping utilised to reduce the risk of environmental impact by limiting the frequency of disconnecting the marine riser due to weather conditions.

✓ Well Construction Decision: Batch Drilling and Completion

3.3.2.4 Drill Fluids and Cuttings Disposal

Drilling fluid (or drilling mud as it is commonly known) is pumped in the borehole when drilling oil and gas wells. The drilling mud fulfils several functions, such as lubrication and cooling of the drill bit, suspension and transport of rock cuttings to the surface, and the provision of 'weight' (hydrostatic pressure) to counter-balance formation pressure. A good mud system will provide an overbalance to the formation pressure and is the first line of defence in well control.

Several types of drilling fluids are available, each with their own specific benefits and challenges and the ultimate selection of which type to use is generally dictated by safety and environmental factors. Drilling fluids are categorised based on their principal constituent in the continuous phase, which may be water, oil, synthetic-oil or gas. The resulting drilling fluids are

called water base muds (WBMs), oil base muds (OBMs), synthetic or pseudo-oil based muds (SBMs or POBMs) and foam muds, respectively. Depending upon the type of drilling fluid, the continuous phase may also contain dissolved organic and inorganic additives as well as finely divided suspended solids of various types.

The preferred type of drilling fluid generally depends on the downhole conditions (formations being encountered and pressures) in the prospective well, both anticipated beforehand, as well as those encountered in real-time during drilling, where each of these mud types will have certain advantages and disadvantages. Figure 3.9 shows the drilling fluid options that have been considered for the Cambo wells.

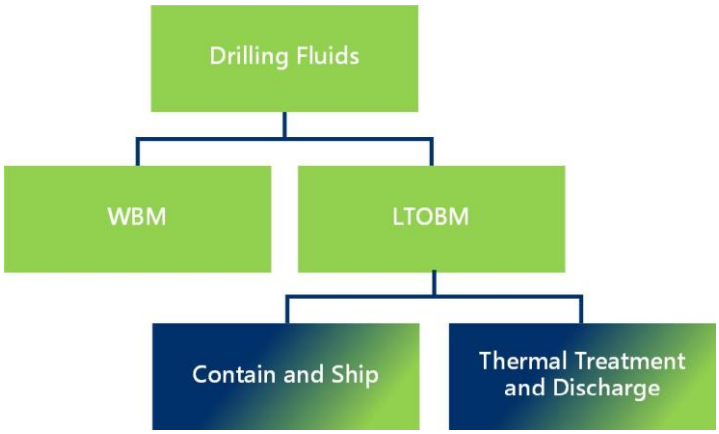


Figure 3.9: Option decision tree for Cambo drill fluids and cuttings disposal

Where technically possible, WBMs are now the most commonly used and discharged on the UKCS, due to their improved environmental credentials compared to the OBMs used (and discharged) until the end of the last century. Where used, the WBMs and generated cuttings from the wellbore are generally discharged to sea.

Modern low toxicity oil-base muds (LTOBMs) are also widely used for the deeper well sections, especially in deviated wells and/or those with challenging and unstable formations. However, due to their oil content, these cannot be discharged to sea. All LTOBM mud and associated LTOBM contaminated cuttings from the well are collected onboard the drilling rig and shipped to shore for appropriate treatment and disposal. Alternatively, oil contaminated cuttings can be thermally treated onboard the drilling unit, after which they are allowed to be discharged, if they contain less than 1 % oil (by weight).

Various types of thermal treatment technology are available in which OBM cuttings are crushed and heated to a temperature which is high enough for oil and water to vaporise from the cuttings. The liquid is separated from the solids, with oil and water condensed later in the treatment process. The advantages of treating and discharging the cleaned cuttings in situ is a reduction in supply vessel journeys, with the potential to eliminate the need for dedicated contain and ship operations. However, it should be noted that thermal treatment units for cuttings are physically large in size and cannot always be accommodated on mobile drilling units that are deck space constraint by design.

WBM will be used to drill the upper well sections at the Cambo field, as is standard practice. Previous drilling campaigns at Cambo have successfully used WBM for the lower well sections and therefore will also be considered for the proposed wells. All cuttings and spent WBM would be discharged to sea.

Alternatively, the lower well sections may be drilled using LTOBM instead, due to the improved operating performance in drilling operations over WBM under certain circumstances. LTOBM contaminated cuttings may either be contained on the drilling rig and shipped to shore for appropriate cleaning and disposal or thermally treated offshore and disposed to sea, depending on the availability of a suitable drilling unit and treatment equipment at the time of drilling.

✓ **Drill Fluids and Cuttings Disposal:** WBM and LTOBM

3.3.3 Reservoir Management

3.3.3.1 Depletion Strategy

Figure 3.10 shows the four options were considered for the depletion strategy for the Cambo field development:

1. Natural depletion;
2. Water injection;
3. Gas injection; and
4. Enhanced oil recovery.

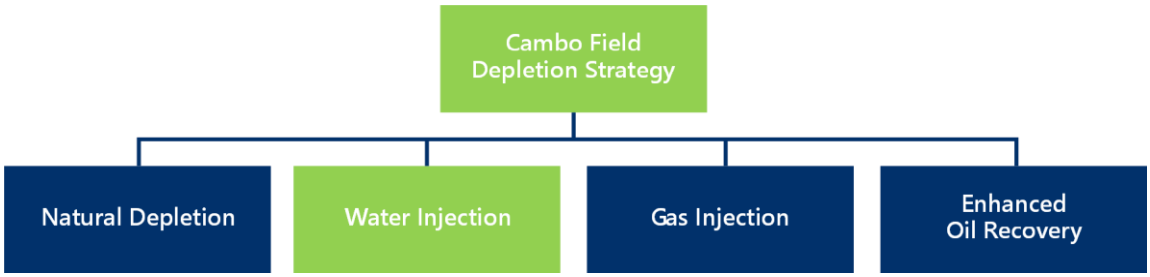


Figure 3.10: Option decision tree for Cambo reservoir management depletion strategy

Based on the goal of maximizing economic oil recovery, water injection (Option 2) is the preferred depletion strategy. Table 3.3 summarises the rationale for rejection of the alternatives.

Table 3.3: Rationale summary for rejection of reservoir depletion strategy

Rejected Option-	Positive Aspects	Rationale for Rejection
Natural depletion/ aquifer support	■ Lower capital expenditure.	■ The extent of any Cambo aquifer is uncertain and cannot be guaranteed to provide adequate pressure support for the predicted reservoir withdrawals.
Gas injection	■ Potentially lower capital expenditure. Reduced environmental impact if not exporting via new pipeline infrastructure.	■ Cambo is structurally flat and gas injection is predicted to have an adverse impact on oil recovery, with gas very quickly breaking through to producing wells unless injected at some distance from the producers.
Enhanced Oil Recovery (EOR)	■ Potential increase in oil recovery.	■ Already favourable mobility; ■ Most polymer waterflood type schemes have been undertaken in reservoirs with significantly heavier and more viscous oil (> 10 cP at reservoir conditions); ■ Limited well stock (Polymer waterflooding would lower water injection rates); ■ Limited field life and unfavourable timescales for implementation of EOR and its economics.

✓ **Development Concept Decision:** Water Injection

3.3.3.2 Artificial Lift Strategy

Artificial lift is needed to sustain attractive production rates at higher water cuts given the low reservoir pressure regime. Figure 3.11 shows the artificial lift methods that have been considered:

1. None - natural flow;
1. Gas lift;
2. Downhole pumps;
3. Flowing wells with seafloor multiphase pumps; and
4. Flowing wells with seafloor gas / liquid separation with and without liquid boosting.

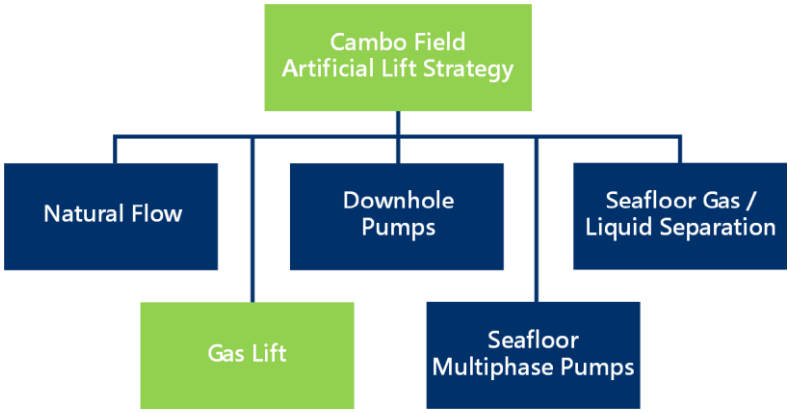


Figure 3.11: Option decision tree for Cambo reservoir management artificial lift strategy

Gas lift (Option 2) is preferred, being a well proven form of artificial lift as used in other West of Shetland subsea developments, involving a simple completion design and having a low

installation and operations risk, avoiding the need for potentially frequent costly interventions to replace pumps. Gas lift is relatively insensitive to variations in fluid properties, gas to oil ratio (GOR) and sand production. Table 3.4 summarises the rationale for rejection of the alternatives.

Table 3.4: Rationale summary for rejection of artificial lift strategy

Rejected Option-	Positive Aspects	Rationale for Rejection
Natural flow	■ Simple well design; ■ Reduced facilities complexity and cost.	■ Whilst Cambo wells are expected to be able to flow naturally, reservoir pressure is too low to sustain attractive production rates at higher water cuts and to kick-off wet wells after shutdowns (or after completion).
Downhole pumps	■ Higher production rate potential per well.	■ Higher downhole and topsides / FPSO interface complexity; ■ High cost of workover in event of downhole pump failure; ■ Sand production.
Seafloor multiphase pumps	■ Reduced backpressure on wells; improved production opportunity; ■ Improved flow assurance potential; ■ Capital expenditure reduction opportunity through simplified (Subsea Umbilicals, Risers, and Flowlines) SURF scope.	■ Limited experience in successful deployment/operation in deepwater harsh environments; ■ High cost of intervention in event of multiphase pump failure; ■ Sand production.
Seafloor processing/pumps	■ Reduced backpressure on wells; improved production opportunity; ■ Improved flow assurance potential; ■ Capital expenditure reduction opportunity through simplified SURF scope.	■ As for seafloor multiphase pumping.

✓ **Development Concept Decision:** Gas Lift

3.3.3.3 Produced Water Management

Figure 3.12 shows the options that have been considered to manage the produced water.

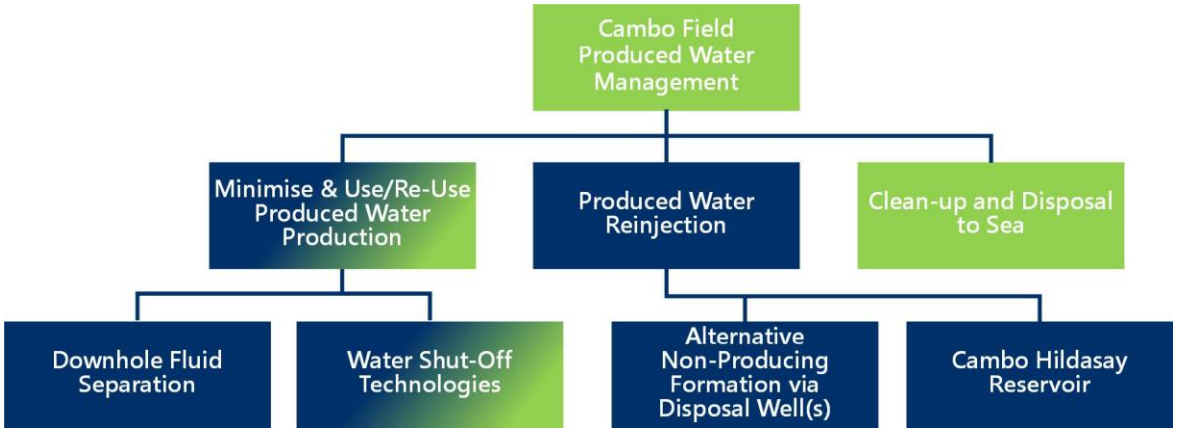


Figure 3.12: Option decision tree for Cambo produced water management

The produced water at the Cambo field development comprises formation water plus gradually increasing quantities of injection water over the life of field. A range of options were considered for the management of production and the disposal of produced water, summarised as follows:

- Minimisation of produced water production during operations;
- Produced Water Reinjection (PWRI) to producing formations; and
- Treatment (clean up) and overboard discharge to sea.

Minimisation of Produced Water Production from Cambo Wells

This could be achieved through two means:

- Water shut-off techniques; and
- Downhole separation.

There will be limited scope to manage water production from the Cambo producers by water shut-off or other downhole means.

The Cambo producers are high angle / horizontal wells targeting clean, relatively thin (low tens of metres thick) homogeneous sands. The Cambo sands are weak, and sand control is required in the wells in order to limit sand production into the wellbore and solids transport to the subsea pipelines and surface facilities or sand fill of the wellbore, restricting or preventing production. The base case lower completion strategy for the producers is alternate path open-hole gravel packs to provide this sand control. The particle size distribution (PSD) of the Cambo sand has been measured by both sieve and laser diffraction techniques. The PSD, in conjunction with industry standard criteria, has been used to select the most appropriate sand control method which suggests open hole gravel back but is also a potential candidate for standalone screens. A sand retention testing program is currently ongoing to evaluate standalone screen performance and determine if this should be employed in Cambo instead of open hole gravel pack.

The Cambo reservoir sands are relatively flat, in a low dip structure, and displacing injection water will quickly move to the producing section. Without suitable thick non-reservoir (e.g. shale) intervals and / or blank pipe within the lower completion, the options to mechanically

shut-off water are limited and are likely to be quickly bypassed by the water in the reservoir. Given the deepwater environment at Cambo, the cost of any well intervention will be high, making it more difficult to justify speculative well interventions. An evaluation of alternative inflow control devices, such as Autonomous Inflow Control Devices (AICDs), indicated negligible benefit in terms of oil production. AICDs are also incompatible with the preferred choice of sand control using alternate path open-hole gravel packing. Whilst offering some benefits in terms of reducing water, similar as for water shut-off, it is expected that water would quickly bypass any individual AICDs which are restricting water inflow. AICDs and other inflow control devices also introduce an additional pressure loss, which would lower production rates.

Downhole separation of hydrocarbons and formation water could be achieved through the inclusion of a hydrocylone stage as part of an electrical submersible pump (ESP) assembly. The separated formation water could then be routed to a disposal formation beneath the produced formation, whilst the remaining reservoir fluids are routed to surface. However, downhole separation as a means of produced water management was discounted as a viable option for the following reasons:

- ESPs were not selected as the optimal artificial lift technique for the Cambo field development;
- The weak nature of the Cambo formation means that some solids production is expected. Injecting such solids into a disposal formation, will drastically reduce injectivity limiting the ability to dispose of produced water and increasing the risk of out of zone injection;
- Downhole separation suffers from a lack of track record and industry experience; and
- Expected high installation and operating costs (assuming pump failure).

Produced Water Injection into a Non-producing Formation Via Disposal Well(s)

This option was reviewed and discounted on the basis of the following:

- Subsurface risks:
  - Uncertainty in the lateral extent and quality of disposal horizons and ability of injection water / pressure to leak off over time. Core water flooding measurements indicate that there will be permeability impairment and a loss of injectivity with PWRI (from solids carryover and oil), even in the excellent quality (Darcy permeability) sands seen in the Cambo Hildasay and as expected to be present in overlying sands. The quality of the deeper Colsay sands is also expected to be good based on the limited data available from the 204/10a-3 well and other wells along the Corona Ridge. However, the Colsay sands at Cambo would need appraisal in order to better delineate the extent of and quality of the sands and to ensure that possible future development of the oil lying in these sands is not jeopardised; and
  - Increased risk of loss of containment if injecting into a shallower sand, especially given the expectation of this horizon containing weak sands (weaker than the Cambo Hildasay reservoir). Fracture modelling of vertical water injectors, indicates that at the disposal rates required (i.e. the produced water volumes of up to 12,719 m^3

(80,000 bbls/d)), that there would most likely be a loss of containment, unless drilling multiple or high angle / horizontal disposal wells, the latter maybe only deferring the loss of containment.

- Additional project costs as a standalone injection system (for PWRI) would be required in addition to the seawater injection system (sized to meet Cambo voidage replacement requirements since PWRI would not contribute to reservoir pressure support and sweep). The cost of installing dedicated disposal infrastructure and the drilling of multiple disposal wells would also be prohibitively expensive. (Drilling into the Colsay, were this to be identified as a possible disposal horizon, would require the drilling of deeper wells, penetrating basalt layers, adding to the duration and cost of drilling the disposal wells).

Options Carried Forward from Initial Screening

Subsequently, two options for produced water management were taken forward for further assessment for the Cambo field development:

- Option 1 - PWRI into the Cambo producing formation; and
- Option 2 - produced water disposal to sea.

Both options were assessed, applying the principles of (Best Available Technique) BAT / Best Environmental Practice (BEP) and considering technical viability and risk. Based on the assessment, produced water disposal to sea (Option 2) been selected for the development.

The criteria against which the decision was made included consideration of Cambo fluid and reservoir properties, environmental impact, safety, production risk and commercial issues in relation to product specifications from the Cambo field. In summary, the rationale for selecting this option is based on two key factors:

- propensity for/consequences of Cambo reservoir souring; and
- reservoir injectivity issues:

Propensity for/Consequences of Cambo Reservoir Souring

Studies indicate that, given its relative low temperature, the Cambo reservoir conditions are favourable to Sulphate Reducing Bacteria (SRB) activity. The reservoir fluids, whilst initially sweet, are expected to sour with Hydrogen Sulphide (H_2S) generation resulting from water injection activity (identified as a requirement for the development as noted in Section 3.3.3.1). SRB growth and respiration will be controlled by the presence of sulphate, a carbon (or nutrient) source such as Volatile Fatty Acids (VFAs) within the reservoir. Cambo formation water contains Volatile Fatty Acids which provides a nutrient for SRB activity and H_2S generation.

Modelling indicates that combined seawater (SW) and PWRI results in an order of magnitude increase in souring and H_2S generation in comparison to seawater injection alone (OilPlus, 2019). The primary causes of this are introduction of VFA in the injected water, and the increasing effect of biofilm sulphide generation mechanism resulting in H_2S generation around the injection wells near the wellbore (and transported through the reservoir). The OilPLus

modelling study considered injection of a combined mix of produced water / seawater and seawater alone, performance sensitivities to various key parameters such as nutrient levels, reservoir temperature, well spacing, etc. The modelled base case predictions give a maximum concentration of H_2S in gas of 1,366 ppm for a mix of PWRI and seawater versus 69 ppm for seawater injection alone. Significant H_2S of tens of ppm in gas occurs within the first few years of production for both PWRI and seawater injection.

The levels predicted with commingled SW / PWRI have significant implications for wells, risers and other facilities integrity management/materials selection. Personnel safety risk through exposure to more elevated levels of H_2S is also increased. In addition to these aspects, the 'Fate of Produced Gas' methodology proposed for the proposed field development is gas export, in order to minimise environmental impact of operations and avoid reliance on operational flaring. The preferred export route is to the West of Shetland Pipeline System (WOSPS) (Section 3.3.5.10). The proposed field development is restricted to a low gas export H_2S specification for entry to WOSPS due to the lack of available capacity in onshore H_2S removal / gas sweetening, and this requires offshore gas sweetening (even for the selected seawater injection only case). At the higher predicted H_2S levels predicted with commingled SW / PWRI, this presents practical design and operational challenges and high operating cost risk.

The proposed gas sweetening methodology selected is solid bed adsorption. Whilst 100 % efficient, adsorption beds are only suitable for relatively low H_2S loadings as the volume of media required is directly proportional to the H_2S loading and the frequency of media changeout. At high H_2S loadings the volume of media required becomes impractical (space and weight) unless a very frequent media changeout is adopted. Solid adsorbent beds are therefore only typically used for polishing applications where the outlet specification is very low. As an example, the solid adsorbent beds for production gas proposed for Cambo are specified based on design gas rates with 20 ppm H_2S loading and a changeout frequency of once per year. This results in the following vessel sizes and weights:

- 34 m^3 bed volume;
- Bed dimensions: 2.8 m (Internal Diameter) × 6.8 m (Tan / Tan dimension);
- Skid dimensions: 7.4 m × 6 m × 9.4 m; and
- Operating weight per bed: 137 tonnes.

With re-injection of produced water, rather than seawater, the H_2S loadings may increase to peak levels of 1,366 ppm. This level of H_2S would make the solid bed size impractical unless a very frequent media changeout is adopted which is not considered acceptable from an operations perspective.

Assessment of measures to manage reservoir souring risk and consequences outlined above have been identified and assessed, including injection water treatment or in situ (reservoir) treatments individually or in combination. Table 3.5 below summarises the outcomes of the assessment of the various techniques.

Table 3.5: Rationale summary for rejection of reservoir souring management techniques

Rejected Option-	Positive Aspects	Rationale for Rejection
Biocide Dosing into Injection Water	Common first treatment strategy for microbial control in injection water.	Not fully effective for PWRI due to the organic content of produced water - often consumed readily. Use generally limited to cleaner seawater injection systems.
Free Radical Generator (FRG) Dosing	Highly effective biocide - promising emerging technique.	Relatively novel and not fully proven/adopted by industry.
Nitrate Dosing into Injection Water	Established SRB activity can be controlled by the injection of nitrate. Some evidence of effectiveness of technique e.g. Schiehallion.	High carbon availability in the injection and formation water increases the degree of nitrate dosing required, with resulting impact on Operational Expenditure (OPEX). Not expected to be effective at Cambo reservoir temperature of 61 °C.
Injection Water Sulphate Removal	Low sulphate injection water reduces barite scaling risk.	Sulphate removal reduces the concentration of sulphate in the injection water but does not eliminate it completely - sulphate removal processes are still able to reduce low amounts of sulphate injected to generate some sulphide in the presence of nutrients. Sulphate concentration of Cambo produced water is low in comparison to seawater at circa 15 mg/l. Modelling indicated only marginal reduction in souring tendency at sulphate concentrations in injection water from 100 mg/l to 40 mg, and so reduction below this low level in produced water / sulphate removal unit (SRU) for PWRI was not considered to be of benefit.
Injection Water Nutrient Removal	Refer to separate Table 3.6 below.	Sulphate removal systems in upstream offshore oil and gas applications generally utilise membrane nanofiltration - required pre-treatment very challenging with produced water reinjection systems, requiring significant filtration with potential for high membrane turnover due to fouling by residual oils, waxes, solids etc.

Table 3.6 summarises considerations and options for treatment of Cambo produced water where the primary objective is to reduce or remove VFA, the main source of nutrients for SRB activity / reservoir souring through PWRI on Cambo. Other secondary nutrients (extra carbon sources, biodegraded crude oil, nitrogen and phosphorus) are not explicitly considered, although the techniques may in some cases also remove these components.

Table 3.6: Rationale summary for reinjection of water nutrient removal techniques

Rejected Option-	Positive Aspects	Rationale for Rejection
Precipitation	None identified	Solid waste generated. No known applications in offshore produced water treatment.
Multi-stage Flash Distillation	None identified	High energy demand and capital costs. No known applications in offshore produced water treatment.
Membrane Separation	Common technique for water purification. Relatively compact technology for offshore applications where weight / space is constrained.	No evidence found of application or effectiveness of nanofiltration for removal of highly soluble, low MW VFA in upstream offshore environment. Not proven for complex high-volume flow waste water streams. Significant pre-treatment requirements to prevent fouling/high turnover of required nanofiltration membranes.
Reverse Osmosis (RO)	Common technique for water purification. Can remove almost all contaminants.	No evidence found of application or effectiveness of RO for removal of VFA from produced water in upstream offshore environment. High pressure/energy requirements. Only trace amounts of contaminants can foul RO membranes.
Electrodialysis	None identified	Difficult process to scale up. Energy intensive. Prone to fouling. No known applications in offshore produced water treatment.
Ion Exchange	None identified	High resin costs and energy demand for resin regeneration. Low adsorption capacity.
Adsorption	Well established technique for produced water treatment.	High retention time / low capacity, high adsorbent costs, energy demand for adsorbent regeneration.
Oxidation	None identified	High energy inputs for ozone system; oil may foul catalyst; may produce sludge and toxic residues; requires some pre-treatment of produced water stream.
Biological	None identified	Not suitable for offshore application - large, heavy process with long residence times.
Solvent Extraction	None identified	No known applications in offshore produced water treatment at scale required for Cambo.
Macro Porous Polymer Extraction (MPPE)	Effective technique for BTEX (Benzene, Toluene, Ethylbenzene and Xylene) and	Not effective for organic acids / VFA separation.

The overview above shows that it is technically possible to filter and treat produced water to remove residual produced solids and dispersed oil in order to mitigate against souring risk. However, the additional treatment package weight and layout requirements plus higher capital and operating costs to achieve and maintain the same or a similar standard to treated seawater (in terms of residual oil, SRB nutrient content, low solids loading and particulate size) are significant. In addition, the required space to accommodate this very sizeable equipment would be a particular challenge on the FPSO.

It should also be noted that depending on treatment type selection, filtration and treatment to manage fouling and operability aspects may not necessarily address potential souring risk as a consequence of produced water reinjection (with the key contributor to increased levels of souring being the introduction of water-soluble nutrients (VFA) in the produced water).

Ithaca Energy has direct experience of an analogous reservoir with PWRI causing major operational challenges, equipment damage including multiple subsea chokes, and injector sand face plugging from carryover and re-injection of fines. The alternate path open-hole gravel packs completions in the producer wells will not completely mitigate the production of fines.

In summary, for the PWRI case, no reliable and cost-effective means of suitably managing souring risk were identified.

Assessment of options to manage reservoir souring risk for the SW-only injection case selected for Cambo are outlined in Section 3.3.3.4.

Reservoir Injectivity

The Cambo reservoir is characterised by relatively weak, unconsolidated rock. As a consequence, downhole sand control and stringent adherence to water injection specifications are required to maintain injectivity and reduce the risk of out of zone injection (OOZI).

The presence of solids and oil in injection water will have an adverse impact on well injectivity from plugging, as commonly observed in oil fields. This effect has been confirmed by core flooding tests performing on Cambo core material, injecting water with a solids loading of 30 mg/l and a range of particle sizes (7.5 mg/l of each of 3, 5, 10 and 25 microns) and in some tests with the addition of 30 ppm oil droplets. In all cases there was a loss of injectivity. The planned sand control should contain larger sand particles but will still allow for the production of fines. As seen in other fields, these finer particles are expected to carry through the separators and be re-injected with PWRI. Fine filtered sea water will be delivered to the wells with a much lower solids loading of only very small particles of less than 5 microns. The coreflood tests indicated a loss of injectivity of 69 % to 78 % over short durations of hours for the above solids loading. This permeability impairment would be expected to increase further over time and the likelihood of longer-term impairment is in excess of 95 %. Coreflood tests with smaller particles of < 5 microns gave reduced impairment of only 23 % to 46 %.

Such degradation in well injectivity is commonly observed with PWRI, as per offset fields such as Schiehallion. Severe loss of injectivity leading to the loss of wells has occurred in some analogue fields. Any significant reduction of injectivity would lead to major production deferrals with loss of reservoir pressure and / or the need to drill replacement water injectors or increase the injector count to maintain water injection rates and voidage replacement.

Therefore, in order to maintain injectivity and hence pressure support, it is preferred to inject filtered and treated seawater to reduce otherwise likely permeability impairment and poor operability of PWRI systems (by sand / fines and / or residual oil in injected produced water).

✓ **Produced Water Management Decision:** Clean up and disposal to sea

3.3.3.4 Reservoir Souring Management

As noted in previous Section 3.3.3.3, as a result of the relatively low temperature of the Cambo reservoir it is expected that the introduction of sulphate via injected seawater will cause reservoir souring through generation of H_2S by SRB. The consequences are also summarised in Section 3.3.3.3. Figure 3.13 shows the options considered to manage reservoir souring.

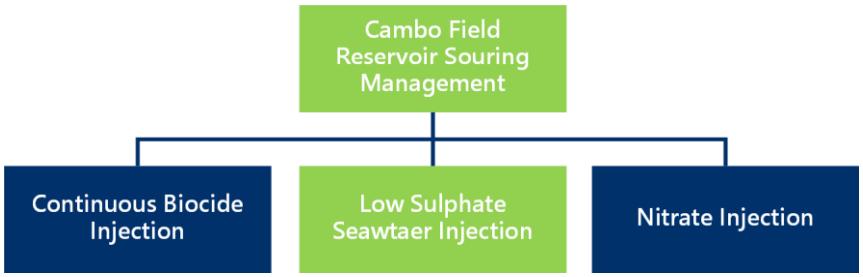


Figure 3.13: Option decision tree for Cambo reservoir souring management

As noted in previous Section 3.3.3.3, as a result of the relatively low temperature of the Cambo reservoir it is expected that the introduction of sulphate via injected sea water will cause reservoir souring through generation of H_2S by SRB. The consequences are also summarised in Section 3.3.3.3.

To reduce the potential for H_2S production in the reservoir, any seawater must be treated before being injected into the wells. The three options considered were:

1. Continuous biocide injection;
2. Low sulphate seawater injection; and
3. Nitrate injection.

Due to the reservoir characteristics, neither continuous biocide injection nor nitrate injection were considered technically viable. Continuous biocide injection is not a proven technology in a sandstone reservoir such as that found in the Cambo field and nitrate injection was rejected as it was not proven technology at the low Cambo reservoir temperatures. Although these were the primary reasons for rejecting these options, Ithaca Energy also noted there were other

potential environmental impacts from these processes which would have required careful consideration.

Low sulphate seawater injection (Option 2) was therefore selected as the souring control measure. The sulphate content of the injected seawater will be reduced through the use of a SRU package.

✓ **Reservoir Souring Management Decision:** Low Sulphate Seawater Injection

3.3.4 Production Facilities

Figure 3.14 shows the various production facilities that have been considered for the Cambo Field development.

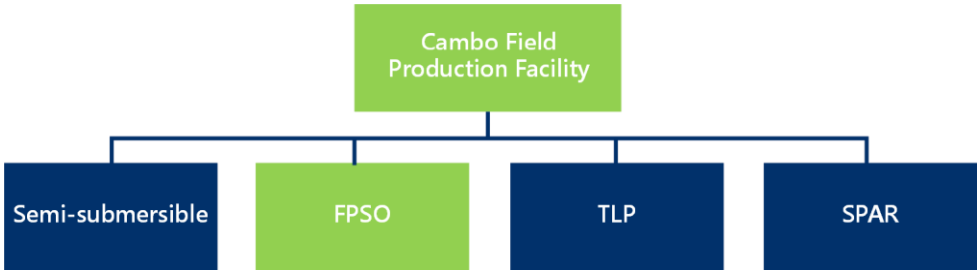


Figure 3.14: Option decision tree for Cambo host facilities

Due to the water depth at the Cambo field, host options focussed on permanently-moored floating systems. Fixed structures (e.g. compliant tower or similar) at the Cambo field location were discounted given the water depth and environmental conditions in the area. To date no such platforms have been deployed at these water depths and in comparable metocean conditions. Non-permanently moored floating options e.g. units operating with dynamic positioning were also ruled out for safety and reliability reasons.

Several floating concepts were considered for the proposed field development:

1. A semi-submersible platform;
2. A floating production storage and offloading (FPSO) vessel;
3. Single point anchor reservoir (SPAR) platform; and
4. A tension leg platform (TLP).

When compared to alternative Sevan-type cylindrical hull units, a new build ship-shaped was selected based on:

- Proven ship-shaped performance in West of Shetland and North Sea environments;
- Greater topside flexibility for process design and maintenance;
- Improved contracting options and fabrication yard availability; and
- Operator familiarity and experience with ship-shaped designs, reducing delivery risk.

Each concept was examined to determine its suitability for the development.

Option 2: FPSO, was selected on the basis that this is a well-proven concept already delivered into the West of Shetland area on the UKCS. Other key factors supporting the decision were:

- Potential cost and schedule opportunities through redeployment of an existing FPSO or conversion of an existing hull; and
- Low complexity and cost decommissioning.

Table 3.7 summarises the rationale for rejection of the alternatives.

Table 3.7: Rationale summary for host facility options

Rejected Option-	Positive Aspects	Rationale for Rejection
Semi-submersible	■ Potential improvement in safety gradient - cargo inventory not stored on facility.	■ No oil storage. Would require dedicated floating storage unit (FSU), subsea storage or new local oil export infrastructure; ■ Oil export via pipeline not cost-effective and challenging from a flow assurance perspective (wax); ■ Environmental impact of a new pipeline to host platform or to the Shetland Islands.
SPAR	■ Potential dry-tree solution. ■ Favourable motion characteristics in harsh environment.	■ Not suitable for full integration before field installation – topsides and hull mated on or near location leading to increased installation risk; ■ Higher sensitivity to payload variation than FPSO and semi-submersible options; ■ High intrinsic cost due to proprietary design and complex project execution.
TLP	■ Potential dry-tree solution. ■ Favourable motion characteristics in harsh environment.	■ Oil storage - FSU or oil pipeline required (refer to semi-submersible platform option); ■ Installation risk in harsh West of Shetland environment; ■ Harsh environment and water depth at upper end of concept capability created challenges for tendon design and increased risk.

✓ **Host Facilities Decision:** FPSO with shuttle tanker oil takeoff

3.3.5 Facilities Design

3.3.5.1 Subsea Infrastructure

The large areal extent and relatively shallow depth of the Cambo reservoir is such that it is not possible to fully develop the field from a single drill centre. Drilling targets have been reviewed by Ithaca Energy and an upside scenario has been identified whereby two of the previously proposed production wells, P11 and P21, which were originally proposed for DC2, could be drilled in a new location from a new third Drill Centre (DC3). The new drill centre would be located to the southwest of the Cambo field. Figure 3.15 shows the options considered for the Cambo subsea infrastructure.

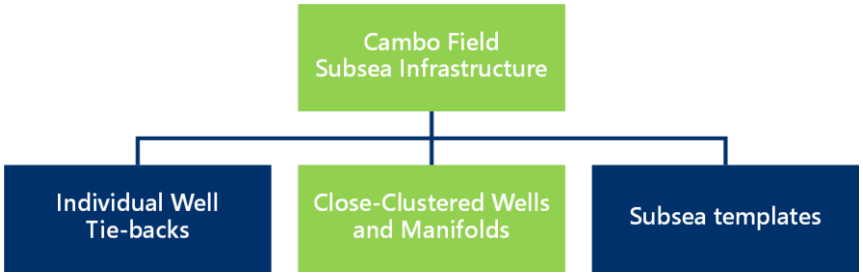


Figure 3.15: Option decision tree for Cambo subsea infrastructure

When considering which subsea system to deploy at the Cambo field, Ithaca Energy considered three principle options:

1. Individual well tie-backs to the host facilities;
2. Close-clustered wells and subsea manifolds; and
3. Subsea templates.

A subsea manifold (at each drill centre) is a structure consisting of pipework and valves designed to transfer oil and gas from individual well into a pipeline or flowline. A subsea template is a larger, heavier steel structure which is used as a base for various subsea structures such as wells, subsea trees and manifolds. All options were considered to be viable for the proposed field development. However, Option 2 (manifolds), was selected on the following basis:

- Clustered wells / subsea manifolds are well suited to a field like Cambo where flexibility in well tophole locations is required to maintain ease of drilling, management of collision risk and ensure optimum well placement;
- Ease of fabrication and hence the ability to take account of design changes later in design and/or field life;
- Drilling programme decoupled from subsea structure delivery; and
- Well proven concept West of Shetland.

Table 3.8 below summarises the rationale for rejection of the alternatives.

Table 3.8: Rationale summary for subsea infrastructure options

Rejected Option-	Positive Aspects	Rationale for Rejection
Individual Well Tie backs	■ None identified.	■ Largest environmental footprint – multiple flowlines from individual wells; ■ Added host facility riser loads; ■ Flow assurance challenges associated with individual well flowlines.
Subsea Templates	■ No hydrate and other flow assurance issues associated with well jumper management; ■ Fewer leak paths and smaller subsea installation scope.	■ Higher complexity/heavier structures – increased fabrication and installation risk; ■ Drilling programme coupled to structure delivery schedule – risk of impact on programme in event of delivery delay; ■ Reduced flexibility in selection of tophole locations.

✓ **Subsea Infrastructure Decision:** Close-clustered Wells and Subsea Manifolds

3.3.5.2 Riser Type Selection

Ithaca Energy has considered two options for the risers (Figure 3.16):

1. Steel catenary risers; and
2. Flexible risers.

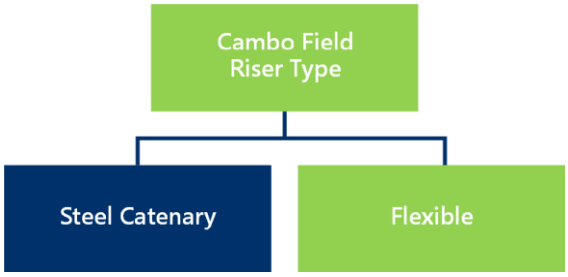


Figure 3.16: Option decision tree for Cambo riser type

Despite higher materials costs, flexible risers were selected over steel catenary on the following basis:

- Higher host vessel loads due to heavier pipe;
- Larger seabed footprint due to a longer layback distance from riser hang-off to touch down point; and
- Higher installation cost.

The selected flexible riser (Option 2) configuration is restrained lazy wave, as illustrated in Figure 3.17.

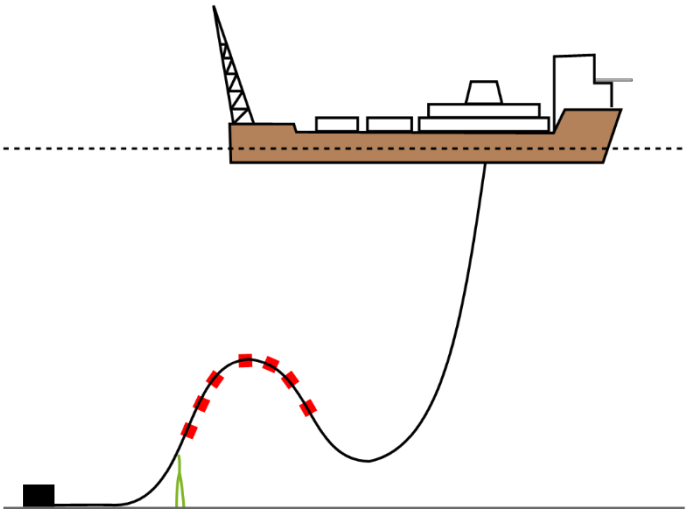


Figure 3.17: Restrained lazy wave riser configuration

A restrained lazy wave configuration improves upon other configurations through the addition of a tether to the riser touchdown point on the seabed. This restricts vertical orientations due to buoyancy changes and minimises the transverse motion which restricts the use of risers of some other configurations.

✓ **Riser Type Decision:** Flexible, Restrained Lazy Wave

3.3.5.3 FPSO Hull Type

The FPSO hull design and selection process covered a range of possible hull forms and design scenarios including redeployment of existing FPSOs, conversion of a trading tanker or new-build options (Figure 3.18).

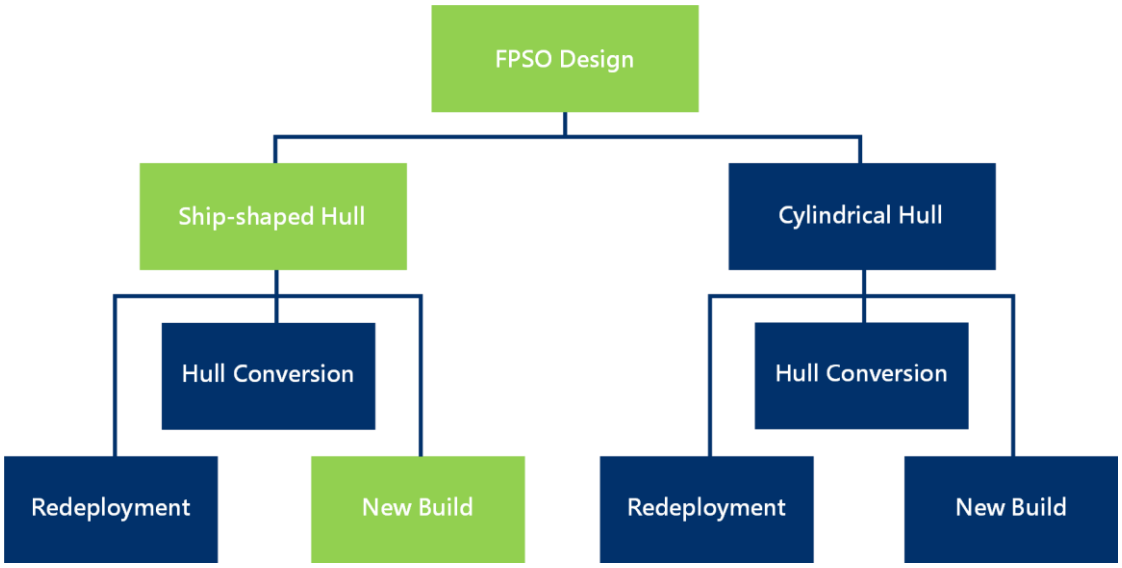


Figure 3.18: Option decision tree for Cambo FPSO hull type

Redeployment

Redeployment of a ship-shaped FPSO was considered however it was ultimately discounted due to the extensive life extension and upgrade works required to meet the harsh environmental conditions at the Cambo field and extended 25-year design life. While candidate FPSOs had adequate riser slots and oil storage capacity, each would require significant structural modifications, upgrades to the turret and mooring system and the addition of electrification systems. Furthermore, the required interventions were highly dependent on the vessel's condition at the time of refurbishment meaning that considerable uncertainty, execution risk, and potential delays could occur making a new-build solution more predictable and technically suitable.

Redeployment of an available, circular (sevan) hull FPSO was evaluated but ultimately determined to be unsuitable due to several critical limitations. Although the FPSO was designed for harsh environments and was compliant with UK regulations, the oil storage capacity would be reduced to 380,000 bbls due to the specific gravity of Cambo oil. This capacity falls significantly short of the 650,000 bbls required for the Cambo field development and this could not be compromised due to commercial constraints. Additional factors included a congested topside layout that limited space for new modules or equipment to be installed, potential stability issues and the need for a complete upgrade of the mooring system to allow for installation in deeper waters. As a result of these factors, it was determined that the circular FPSO was unfit for redeployment to the Cambo field.

Conversion

Potential conversion options were identified based on the outcome of a market enquiry undertaken to assess the availability of existing tankers which may be suitable for the Cambo field development. However, this option was not pursued further due to a lack of positive feedback from the market. It was concluded that, although conversion would be technically feasible, adapting a vessel for harsh environments such as the North Sea reduces many of the typical advantages associated with FPSO conversions. This is primarily due to the structural modifications required, including reinforcements and green water protection, which diminish the cost and schedule benefits usually expected from such conversions.

New Build

When considering a potential new-build FPSO, two options were considered. These were a circular (or sevan type) FPSO with spread mooring system or a ship-shaped FPSO with turret mooring system.

The ship-shaped FPSO would require to be turret moored as, from a technical standpoint, using a ship-shaped hull with spread mooring is considered unfeasible due to the harsh environmental conditions at the Cambo field. Therefore, a ship-shaped FPSO would be at a disadvantage in terms of mooring system complexity and additional cost of turret and swivel system. Conversely, a cylindrical hull offers the advantage of simplified mooring and fluids

transfer arrangements. However, this design presents disadvantages which carry more risk to the project execution. Ithaca Energy undertook a review of FPSOs operating in the UK and Norwegian sectors which revealed that most FPSOs were ship-shaped with turrets. While the circular (sevan) type configuration remained a valid option, it had seen fewer applications in this region.

The circular (sevan) FPSO design presents several challenges. The topside layout is complex and congested, making construction and integration more challenging. Additionally, there are potential limitations in identifying construction yards with the experience and capability to execute the design. This introduces significant schedule risks due to the concept's lower maturity. Globally, and within the UK sector, adoption of the circular (sevan) style has been limited, with only five units in operation in the North Sea compared to nineteen ship-shaped FPSOs currently in operation.

In conclusion, the key risks for adaptation of circular hull design were considered to be:

- A limited number of yards capable of constructing a large diameter vessel (circa 85 m), and
- Design constraints associated with the effect of topsides weight on the vertical centre of gravity, thereby making a circular (sevan) hull more sensitive from hull stability point of view.

Such sensitivities could impose challenges on the arrangement of topside equipment, posing less flexibility to accommodate possible design variations during the detailed design / execute phase of the Cambo field development.

Any advantages of a circular (sevan) design were judged to be minimal when considering the above risks.

Given the water depth at Cambo field, approximately 1,073 m to 1,105 m, a traditional catenary mooring configuration is ruled out. Therefore, the planned mooring system would be of taut configuration, composed of chain and polyester sections. The use of sonar reflectors on the mooring lines is still being assessed with two options under consideration:

- A steel buoy approximately 200 m below sea level; or
- A metal midline connector.

Both of these options would act as sonar reflectors and a final decision will be made during the FEED phase.

Table 3.9 summarises the rationale for rejection of the FPSO alternatives.

Table 3.9: Rationale summary for rejection of discounted hull options

Rejected Option-		Positive Aspects	Rationale for Rejection
Ship shaped	Hull conversion	■ Potentially greater equipment footprint and weight capacity. ■ Potentially wider range of contractors capable of delivery of ship-shaped units. ■ Environmental benefit of re-use/recycle of existing unit.	■ Limited hulls available with sufficient strength and fatigue capacity for operation in West of Shetland environment; ■ Only suitable hulls identified have already been in service for many years – significant cost, schedule, execution and operational longevity risk; ■ May require retrofit of active station-keeping (common to all ship-shaped options) and added thruster fuel consumption.
	Redeployment	■ Positive aspects similar to hull conversion.	■ Very limited pool of technically viable units available; ■ Technically viable units are not available to tie-in with project schedule; ■ A suitable commercial model could not be agreed.
Cylindrical	New build	■ Simplified mooring system. (i.e., No turret needed to manage harsh environmental condition at Cambo).	■ Limited number of construction yards with capability and experience to build a large diameter cylindrical unit; ■ Complexity of weight control, management of vertical CoG and subsequent layout issues (i.e., congestion of design); ■ Less flexibility to design variations during detail design; ■ Increased cost/delivery risk compared to typical ship-shaped hull.
	Redeployment	■ Positive aspects similar to new build cylindrical option; ■ Environmental benefit of re-use/recycle of existing unit.	■ No suitable redeployment candidates identified.
	Hull Conversion	■ Positive aspects similar to new build cylindrical option; ■ Environmental benefit of re-use/recycle of existing unit.	■ No suitable hull conversion candidates identified.

✓ **FPSO Hull Type Decision:** New Build Ship-shaped Hull

3.3.5.4 Main Power Generation

Primary Power Source

The majority of the atmospheric emissions from an offshore oil and gas installation come from the need to maintain a reliable power supply for production, maintenance of safety / life support and environmental protection systems. Figure 3.19 shows the main options considered as the primary power source for the Cambo FPSO.

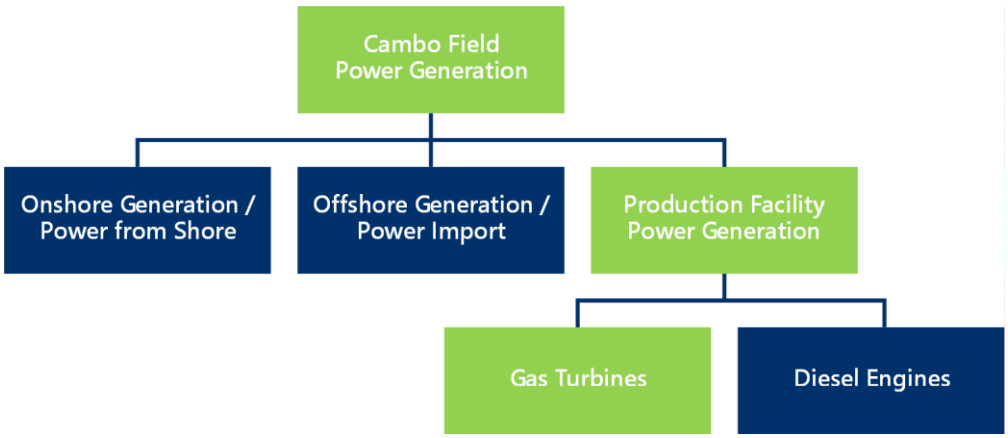


Figure 3.19: Option decision tree for Cambo primary power source

Seven principle power supply options for the proposed Cambo facility were considered with the above in mind:

1. Onshore power generation via non-renewable sources and power import via cable from shore;
2. Onshore power generation via renewable sources and power import via cable from shore;
3. Offshore renewable energy;
4. Offshore generation by a third party with cable import to Cambo;
5. Combined cycle gas turbines;
6. Local host facility gas turbines – conventional offshore power generation using gas turbines and produced gas from the Cambo field; and
7. Local host facility gas turbines with local Carbon Capture and Storage (CCS)

Each concept was examined to determine its suitability for the proposed field development. Table 3.10 summarises the rationale for rejection of the alternatives, with further commentary added on Option 2 in subsequent text.

Table 3.10: Rationale summary for rejection of power generation options

Rejected Option-	Positive Aspects	Rationale for Rejection
Option 1 Onshore power generation from non-renewable sources and import from shore	■ Reduced offshore greenhouse gas (GHG) emissions from Cambo; ■ Increase in surplus gas export to WOSPS.	■ Insufficient electrical power generation capacity on the Shetland Islands to meet Cambo power / heat demands; ■ No credible routes identified to establishing other sources of onshore, non-renewable power for export to Cambo. Environmental benefits over local non-renewable generation via Cambo produced gas also unclear; ■ Potential environmental impacts from onshore works and cable laying from shore; ■ Provision of proven technologies suitable for delivery of subsea electrical cable over distance to Cambo not yet fully evaluated.
Option 2 Onshore power generation from renewable sources and import from shore	■ Delivery of Viking Wind Farm and Shetland High-Voltage, Direct Current (HVDC) Interconnector projects provide a potential source of power for Cambo from a renewable source; ■ Reduced offshore GHG emissions from Cambo; ■ Increase in surplus gas export to WOSPS.	■ Uncertainty regarding onshore power connection infrastructure; ■ Potential environmental impacts from Cambo onshore works and cable laying from shore; ■ Provision of proven technologies suitable for delivery of subsea electrical cable over distance to Cambo not yet fully evaluated.
Option 3 Offshore renewable energy	■ Reduced GHG emissions from Cambo; ■ Increase in surplus gas export to WOSPS.	■ Floating offshore wind turbines would be required at Cambo given the water depth. This technology is not yet proven for such a location and there are no existing or planned offshore renewable energy developments in this area; ■ Marine renewable energy converters not technically mature at scale required for Cambo power needs; ■ Back-up generation capacity required to address intermittency of renewable power sources. Potential challenges with balancing power sources; ■ Provision of proven technologies suitable for delivery of subsea electrical cable over distance to Cambo not yet fully evaluated.
Option 4 Offshore power generation and power import	■ Utilisation of spare capacity from existing offshore power generators; ■ Reduced GHG emissions from Cambo.	■ No identifiable options for import from existing facilities or new renewable / other offshore energy projects with timing and capacity to meet Cambo power needs.

Rejected Option-	Positive Aspects	Rationale for Rejection
Option 5 Combined Cycle Gas Turbines	■ Higher efficiency than conventional open-cycle gas turbines; reduced fuel consumption and GHG emissions.	■ The following additional equipment would be required to maximise the benefit from a Combined Cycle Gas Turbine: • A heat recovery steam generator (HRSG) • A steam turbine (ST) • Condenser systems • Significant auxiliary equipment (pumps, water treatment, ducting) ■ The additional equipment would add significant weight to the topsides resulting in the requirement for additional topsides structural steel and deck strengthening. This in turn will affect the centre of gravity of the vessel and most likely require a broader hull to ensure vessel stability. ■ The additional costs, complexity and impact to the overall size of the FPSO would not be justifiable during the lifecycle of the FPSO, especially where future electrification is considered.
Option 6 Local host facility gas turbines	■ Conventional, well-proven and reliable power generation source; ■ Heat can be recovered from exhaust gases to meet process heating requirements; ■ Dual fuel (fuel gas or diesel) turbines provides opportunities to improve operational efficiency, provides greater flexibility and equipment is standardised.	■ Higher GHG emissions than renewable or Combined Cycle options.
Option 7 Local host facility gas turbines with local CCS	■ Local CCS reduces environmental impact of local non-renewable power generation.	■ Technologies more suited to onshore deployment. Compact local CCS technologies of size / weight suitable for offshore deployment not yet technically mature; ■ High CCS system energy requirements offset emissions reduction potential; ■ No obvious suitable CCS reservoir in the vicinity of the Cambo field development – storage potential, seal and local structure challenges.

Assessment of Options 2 and 3, electrification via onshore or offshore power generation / import from renewable sources, concluded that neither were viable for the Cambo field development alone on the grounds noted in the table above. However, given the importance of electrification of upstream oil and gas assets to the delivery of the Oil and Gas Authority (OGA) Strategy and achievement of net zero goals, opportunities to address the challenges of these options through collaboration with other operators in the West of Shetland area were identified.

Ithaca Energy and the previous Cambo joint venture partners were instrumental in the establishment of the West of Shetland electrification (WoSE) workgroup to explore opportunities, and to address the challenges of electrification through collaboration with other West of Shetland upstream oil and gas Operators and stakeholders.

Work to date supports the view that there is potential for collaboration, although significant technical, commercial and regulatory challenges remain to be addressed. Timelines for other development projects also remain uncertain and do not align with the Cambo field development programme. However, to retain optionality and the potential to improve emissions performance of the Cambo FPSO during production operations, the facilities will be designed to facilitate potential future electrification (either from onshore or offshore renewable sources) if and when these challenges are suitably addressed.

Specifically, provisions are being made in the FPSO design for potential future installation of a power import connection and required electrical infrastructure for power conditioning and distribution.

✓ **Power Generation Type Decision:** Conventional Local Power Generation via Gas Turbines; provision in facilities design for potential future electrification

Turbine Fuel Supply

The decision was made for the turbines to be all dual fuel (fuel gas or diesel). This option provides the project with the opportunity to improve on operational efficiency, and also improves greater flexibility, standardised equipment and redundancy for power generation start-up.

Consideration was given to single (gas) fuelled units which, whilst technically feasible, was not preferred for Cambo due to the lower availability and loss of flexibility in such units to accommodate transient events, such as recovery from unplanned shutdowns on the FPSO, interruptions to fuel gas import supply from WOSPS (planned or unplanned) or outages of the FPSO gas import or fuel gas systems. Furthermore, dual fuel units offer more flexibility during commissioning and periodic plant turnarounds.

Alternative low / no carbon fuels were considered (e.g. hydrogen blended with natural gas, ammonia or biofuels). However, these options were ruled out on technology maturity for offshore deployment and fuel supply logistics grounds.

Current Cambo production forecasts indicate that the field will become gas deficient in the future (currently estimated to sometime between 2038 and 2043). Two options were considered to address future fuel gas deficiency.

- Import gas from WOSPS; and
- Increase in the use of diesel fuel to supplement available fuel gas.

The decision was made to import gas from the WOSPS system. This option is better environmentally as fuel gas combustion generates lower emissions than equivalent diesel consumption. It is also the preferred option in terms of value, as diesel is higher cost.

✓ **Turbine Fuel Supply Decision:** Dual fuel (Fuel Gas and Diesel)

Turbine Configuration

Careful selection of power generation configuration on the Cambo FPSO is essential for the provision of a secure, reliable and flexible power supply. Three options were considered:

- N configuration to supply the defined load (i.e. installation of N turbines where N is the number of turbines required to meet the power output requirement) to provide the defined load;
- N+1 configuration to supply the defined load (i.e. back-up is provided through provision of an additional turbine); and
- 3 × 50 % configuration with adequate capacity to deliver load shedding and retain some power requirements should one of the duty turbines trip during a period when the stand-by turbine is offline for maintenance.

Option 1 reduces the number of installed turbines required to meet the power requirements, but the loss of one turbine could adversely impact on production and operating efficiency. An N+1 configuration (as per Option 2) allows for maintenance and overhauls so that the required generation capacity is available the majority of the time but remains a single point failure with no "spinning reserve". Option 3 (3 x 50 %) offers a level of redundancy that would allow two turbines to load share and therefore provide sufficient reserve power to reduce the impact on restart if there was an operational issue resulting in the loss of a turbine.

✓ **Turbine Configuration Decision:** 3 x 50 % turbines

Turbine Emissions Control

There are various techniques for reducing emissions from turbines, and these are generally described as wet or dry. Wet technologies involve the injection of water or steam and require installation of large purification systems and are not considered a viable option offshore. The project therefore considered the following three main options when considering turbine emissions control:

1. Install dry low NO_x emissions (DLE) dual fuel turbines;
2. Install DLE turbines on fuel gas; and
3. Install DLE-ready dual fuel turbines.

Industry experience to date in the use of DLE dual fuel turbines has been mixed, with reliability, operability issues and mechanical failure (e.g. combustor and exhaust collector failures) experienced. In addition, the mechanical and emissions performance of DLE turbines is dependent on load – high loads have resulted in satisfactory performance, but operation at

lower loads has proved problematic. However, based on evaluation and engagement with power generation package vendors, dual fuel units have been selected that are gas fuel DLE / liquid fuel LDI (Lean Direct Injection) equipped (Option 2).

The key issues relating to DLE option, i.e. cost, performance and reliability on fuel gas have been addressed sufficiently to give confidence in this approach. Furthermore, LDI is an advancement in design to allow more operational flexibility in terms of liquid fuel quality for offshore applications (one of the key issues identified with the traditional dual fuel DLE approach) and therefore presents a lower risk compared to dual fuel DLE options. With the facility to import gas on Cambo, it is envisaged that the use of liquid fuel will be limited, thus minimising emissions, compared to traditional dual fuel DLE.

✓ **Turbine Emissions Control Decision:** Gas fuel DLE / liquid fuel LDI

3.3.5.5 Major Drive Selection

FPSO host high pressure (HP) compression and water injection systems require significant power to operate. In terms of how these systems will be driven, Ithaca Energy has considered the following:

- Gas turbine drives; and
- Electric motor drives.

Once it was established that there was sufficient gas turbine generator capacity to support Option 2, this option was selected as it provided several advantages over Option 1. This included increased reliability and savings in space, weight and cost, as well as representing the BAT.

Electric drive has significantly lower emissions and higher energy efficiency than is seen by direct drive and is the environmentally preferred option. In addition, electric drive is considered to be the inherently safer design option which, whilst higher CAPEX, does have an overall lower OPEX with reduced fuel demand by virtue of higher efficiency.

✓ **Major Drive Selection Decision:** Electric Motors

3.3.5.6 Produced Water Treatment

As noted in Section 3.3.3.3, the proposed produced water management plan is clean-up and disposal to sea, such that the identified Cambo reservoir souring and injectivity challenges can be mitigated. Produced water separated from the 1st and 2nd stage separators and the mechanical coalescer stage of separation will be commingled and routed to a produced water treatment package prior to discharge.

The package will be designed to treat water production up to design capacity to a target residual dispersed oil in water specification of 15 mg/l or less (measured on a monthly average basis). Whilst a higher residual oil in water specification would meet current UK statutory requirements for produced water discharge (at present a maximum monthly average of

30 mg/l), the lower target recognises that the OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations requires that any plans to construct new offshore installations should take as a point of departure the reduction of discharges and, where appropriate, the achievement of zero discharges of oil in produced water into the sea.

The design capacity of the produced water treatment package has been set based on subsurface simulation and production profiles for the Cambo field.

The setting of a maximum monthly average of 15 mg/l has been informed by understanding of current performance of other offshore operations in the UKCS and further afield where disposal of produced water to sea is required, and in recognition of practical challenges identified in achieving zero discharge of oil in produced water offshore where produced water reinjection (or measures to avoid produced water production to surface) are not feasible. The approach to produced water treatment system design has however been to achieve as low a concentration as practicable in line with the principles of BAT, and balance between environmental performance and technical / cost aspects.

Laboratory test work has been completed to assess Cambo oil / water separation and emulsion formation and stability characteristics. In summary, the results indicated that good separation efficiency can be achieved, and the results have been utilised to determine the proposed produced water clean-up package configuration.

The produced water treatment package is anticipated to include desanding hydrocyclones, deoiling hydrocyclones, produced water gas flotation vessel and gas flotation unit (GFU) eductor. Recovered oil is pumped back to the separation train. In order to maximise the performance of the flotation unit it is also planned to inject deoiler and / or flocculant chemicals upstream of the unit. This will aid the coalescing of the oil droplets in the unit and improve performance.

The proposed produced water treatment package suppliers have confirmed that the proposed configuration will meet discharge specification requirements (15 mg/l) with the Cambo fluids.

Treated produced water will be mixed with colder produced water from the first stage separator prior to discharge, as modelling work identified a material benefit in terms of plume dilution factor and reduction in extent of any environmental effects arising from produced water disposal. Other steps taken in this regard include optimising the disposal caisson dimensions and exit orientation from the FPSO.

Pressure drop and turbulence that create oil / water emulsions in the treatment system shall be minimised, where possible, by the incorporation of low shear pumps and valves in the package design.

Consideration has been given to the use of tertiary / produced water polishing treatment to target further removal of dissolved hydrocarbon components and reduce oil-in-water concentration. MPPE and membrane technologies have been amongst the tertiary treatment

options considered. However, the deployment of these technologies on the Cambo FPSO is not proposed given lack of track record in offshore applications at the scale required for the prevailing produced water production rates. The resulting package deck space and weight requirements, and increased utility / operations challenge to maintain performance of these tertiary systems, are considered to offset the potential incremental benefit in residual oil in water reduction.

However, some deck space and weight capacity will be reserved for the addition of future equipment, and this may include tertiary produced water treatment in case the monthly average oil in water concentration limit is reduced further in the future.

Produced water disposal metering will be implemented such that accurate measurement of the volume of produced water discharged can be achieved. In addition, residual oil in water measurement / sampling provisions shall conform to the Department of Business, Energy and Industrial Strategy (BEIS) guidance[3] (BEIS, 2018) on methodologies for sampling of produced water and other hydrocarbon discharges.

Certain process upsets or outages (e.g. slugging, loss of deoiler chemical injection, reduced hydrocyclone efficiency caused by blockages, etc.) may occasionally cause a temporary increase in the oil in water concentration. If, under these circumstances, the oil in water discharge specification cannot be met, the produced water can be routed to and stored in hull tanks for later processing and disposal overboard within the required specification. Should sufficient volume be unavailable for storage of produced water, the procedure will be to restrict or shut in production until the produced water is brought back into specification.

3.3.5.7 Flaring and Venting

Gas produced from the Cambo field development in excess of requirements for powering the FPSO will be conditioned and exported via the gas export pipeline. In addition, hydrocarbon vapour from the FPSO cargo storage system will be recovered and returned to the topsides process system via a vapour recovery system. However, there are a number of other low rate sources of hydrocarbons that may be routinely routed to the FPSO flare system. Figure 3.20 shows the three flaring options considered:

1. Operational flaring – open flare, with routine operational flaring of low rate and low pressure sources of hydrocarbons;
2. No operational flaring – recovery of all sources of continuous operational flaring; and
3. High Integrity Pressure Protection System (HIPPS) Closed flare – recovery of all sources of continuous operational flaring; high pressure (HP) and low pressure (LP) flare tips isolated in normal operations.

[3] Although the functions of BEIS have been transferred to the DESNZ, the published methodology for sampling produced water and other hydrocarbon discharges remains in the name of BEIS.

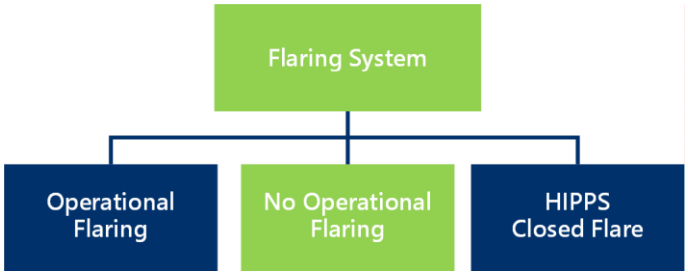


Figure 3.20: Option decision tree for flaring and venting at Cambo

Option 3 requires interconnection between the FPSO flare and either dedicated recovery compression or vapour recovery / LP compression systems for collection and return of hydrocarbons from the flare to the process. A HIPPS at the inlet of the process facilities will eliminate releases of hydrocarbons to the flare system due to the blocked outlet of the 1st stage separator. The flare tips may be purged with nitrogen and feature ballistic or other pilot systems to ignite the flare when required.

In all options, non-routine flaring during plant upsets or readiness for full or partial plant shutdown (e.g. for maintenance) will still occur.

Each option was reviewed to assess suitability for the Cambo FPSO. Option 1 was ruled out as the project is committed to a no operational flaring approach in line with the OGA Strategy and net zero expectations.

Option 2 has been discounted as there would be a requirement for a continuous flare pilot flame.

Option 3 would be considered to offer the BAT and would deliver the following :

- Safe design through the integration of safety and process systems;
- Installation of a Vapour Recovery Unit; and
- Installation of a ballistic ignition system to light the flare on demand.

Any routine operational flaring on the Cambo FPSO has been scoped out of the design process through the following measures:

- Use of inert gas (nitrogen) instead of hydrocarbon gas for:
  - Compressor dry gas seals;
  - Utility system blanketing (e.g. heating and cooling medium expansion vessels);
- Recovery of low pressure hydrocarbon sources frequently routed to LP flare via the FPSO vapour recovery unit, including produced water treatment / gas flotation system and TEG (triethylene glycol) regeneration system; and
- Specification of valves connected directly to the flare to minimise fugitive emissions;

There will be no routine cold venting (discharge of unburnt hydrocarbons) from the Cambo FPSO. Low volume, non-routine venting may be necessary from time to time in readiness for maintenance e.g. hydrocarbon freeing in preparation for cargo tank entry. However, any venting will normally be recovered by the vapour recovery unit.

✓ **Flaring Decision:** HIPPS Closed flare

3.3.5.8 Cargo Storage Tank Blanketing

In order to prevent the build-up of a flammable mixture in the FPSO cargo oil tanks (COTs) during production operations, a positive pressure must be maintained to avoid air ingress. To achieve this, the COTs must therefore be blanketed with some form of non-oxygenated vapour. Further, vent gas from FPSO cargo tanks can present a significant source of volatile organic compounds (VOCs) including methane and is a potentially significant environmental impact.

Figure 3.21 shows the three options considered for cargo storage tank blanketing:

- Blanketing with hydrocarbon (fuel) gas with displaced gas/vapour recovery back to the FPSO process;
- Inert gas blanketing and discharge of displaced gas to LP flare; and
- Inert gas blanketing and discharge of displaced gas to cold vent in a safe location.

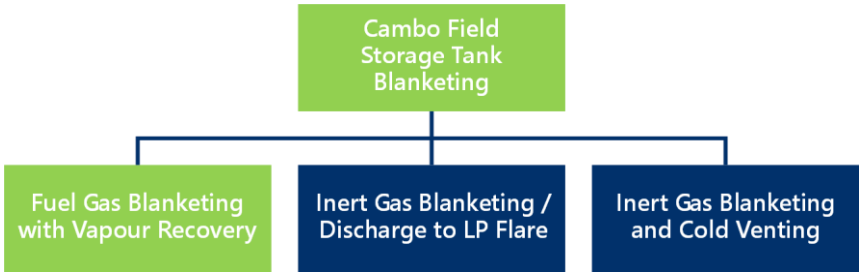


Figure 3.21: Option decision tree for Cambo FPSO cargo storage tank blanketing

Option 1 was chosen. Whilst not the most inherently safe or lowest complexity / CAPEX option, this is considered BAT, with no VOC or methane emissions in normal operation.

Table 3.11 summarises the rationale for rejection of the alternatives.

Table 3.11: Rationale summary for rejection of cargo storage tank blanketing options

Rejected Option-	Positive Aspects	Rationale for Rejection
Option 2 Inert gas blanketing/discharge to LP flare	■ Lower complexity; inherently safe.	■ VOC and methane emissions not minimised, but reduced through flaring rather than venting; ■ Loss of oil over life of field due to evaporative losses; ■ Inert Gas (IG) blanket more corrosive than hydrocarbon gas.
Option 3 Inert gas blanketing and cold venting	■ Lower complexity.	■ High VOC and methane emissions; ■ As above for evaporative losses and corrosivity.

✓ **Storage Tank Blanketing Decision:** Fuel Gas with Vapour Recovery

3.3.5.9 Oil Export

Figure 3.22 show the options considered to export the Cambo oil from the FPSO to market.

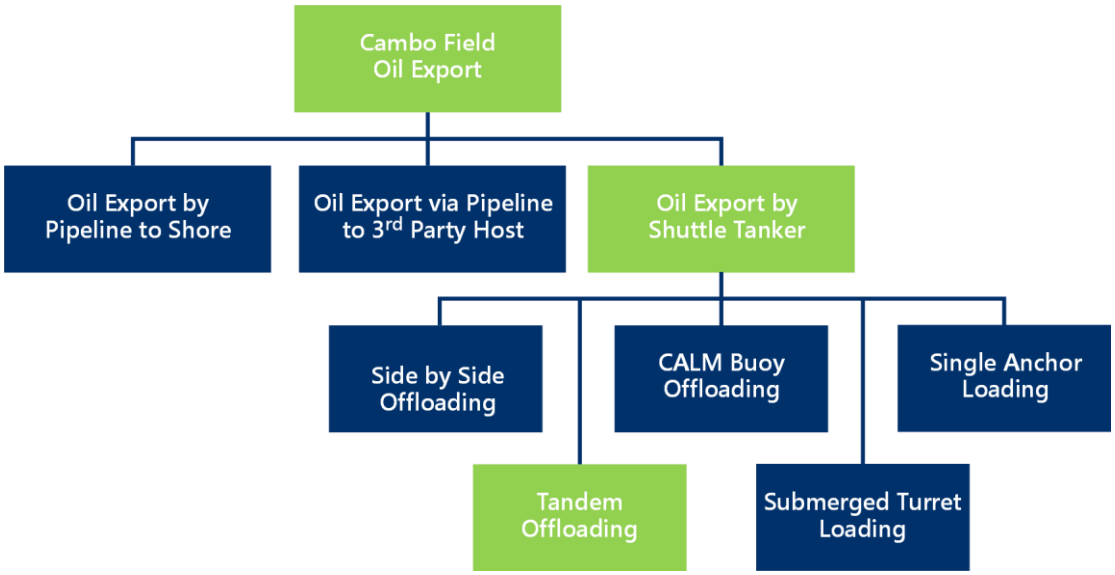


Figure 3.22: Option decision tree for oil export from the Cambo FPSO

Oil export via shuttle tanker was selected based on lack of existing oil export infrastructure in the area and flow assurance issues associated with dry oil export from the Cambo field.

In terms of oil offloading to shuttle tanker, tandem offloading was selected as the lowest risk and complexity option. The presence of significant hydrocarbon storage inventories in the field and potential for loss of containment as a result of offloading hose failure or damage was recognised but was considered to be tolerable when compared with risks of more complex

buoy options. Tandem offloading is also commonly conducted in other West of Shetland FPSO developments, with a range of North Sea tankers accessible for offloading operations.

✓ **Oil Export Decision:** Export by Shuttle Tanker with Tandem Offloading

3.3.5.10 Disposal of Produced Excess Gas

Figure 3.23 shows the options that were considered for disposal of hydrocarbon gas produced in excess of fuel requirements for Cambo:

1. Pipeline export to shore for processing / distribution;
2. Offshore sale to third party – sale of excess produced gas to other nearby fields that may be gas deficient;
3. Gas to Products – processing of gas to alternative liquid gas / other products;
4. Gas to Power – offshore power generation and export to other users;
5. Gas reinjection to a non-producing horizon; and
6. Operational flaring.

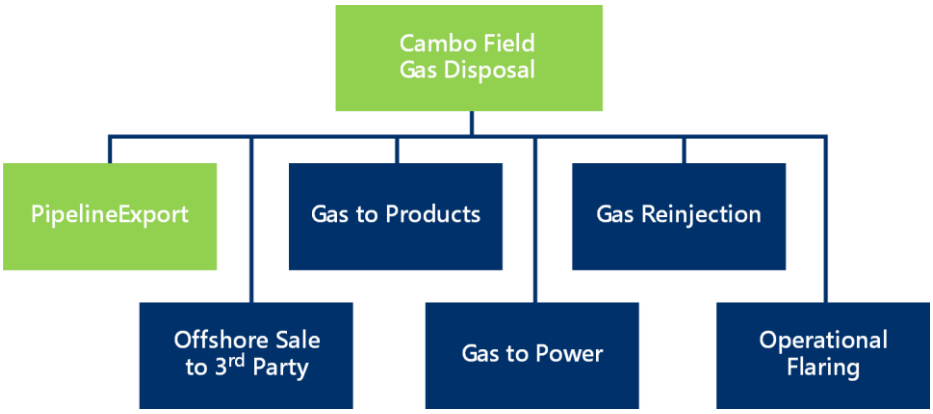


Figure 3.23: Option decision tree for disposal of excess produced gas from the Cambo field

Option 1, gas export by pipeline to shore was selected, allowing the modest volumes of produced gas from the Cambo field to be brought to market. The gas export pipeline, through import from the host pipeline system, will also provide a source of fuel gas to support initial start-up and to provide efficient recovery from production shutdown / blowdown. The availability of import gas is particularly important in the event that Cambo production has declined such that the field becomes fuel gas deficient and there are still no renewable electricity sources available at that time to provide alternative power. The latter two points will therefore, potentially, assist to minimise reliance on liquid fuel import and consumption.

The specifications and datasheets provided to vendors for relevant fuel gas users include composition data for the required range of design cases (including fuel import).

Table 3.12 summarises the rationale for rejection of the alternatives.

Table 3.12: Rationale summary for rejection of produced gas disposal options

Rejected Option-	Positive Aspects	Rationale for Rejection
Option 2 Offshore sale to third party	■ Reduced CAPEX.	■ Challenged by lack of developed fields in vicinity of Cambo; ■ Utilisation of excess gas dependent on third party requirements – current lack of demand.
Option 3 Gas to products	■ None identified.	■ Major processing requirements offshore not justified by modest volumes of excess Cambo gas.
Option 4 Gas to power	■ None identified.	■ No nearby power demand identified; ■ Modest excess gas volumes limit power availability and justification for infrastructure to shore.
Option 5 Gas reinjection	■ Reduced capital expenditure in comparison to export pipeline solution.	■ No suitable non-producing horizon identified; ■ Risk of gas recycle to producing wells, utilising gas handling capacity and reducing production.
Option 6 Operational flaring	■ Low complexity and cost.	■ Routine operational flaring Incompatible with Ithaca Energy or Joint Venture (JV) partner philosophy for new field developments.

✓ **Fate of Produced Gas Philosophy Decision:** Gas Export by Pipeline to Shore

3.3.5.11 Gas Export Pipeline Route Selection

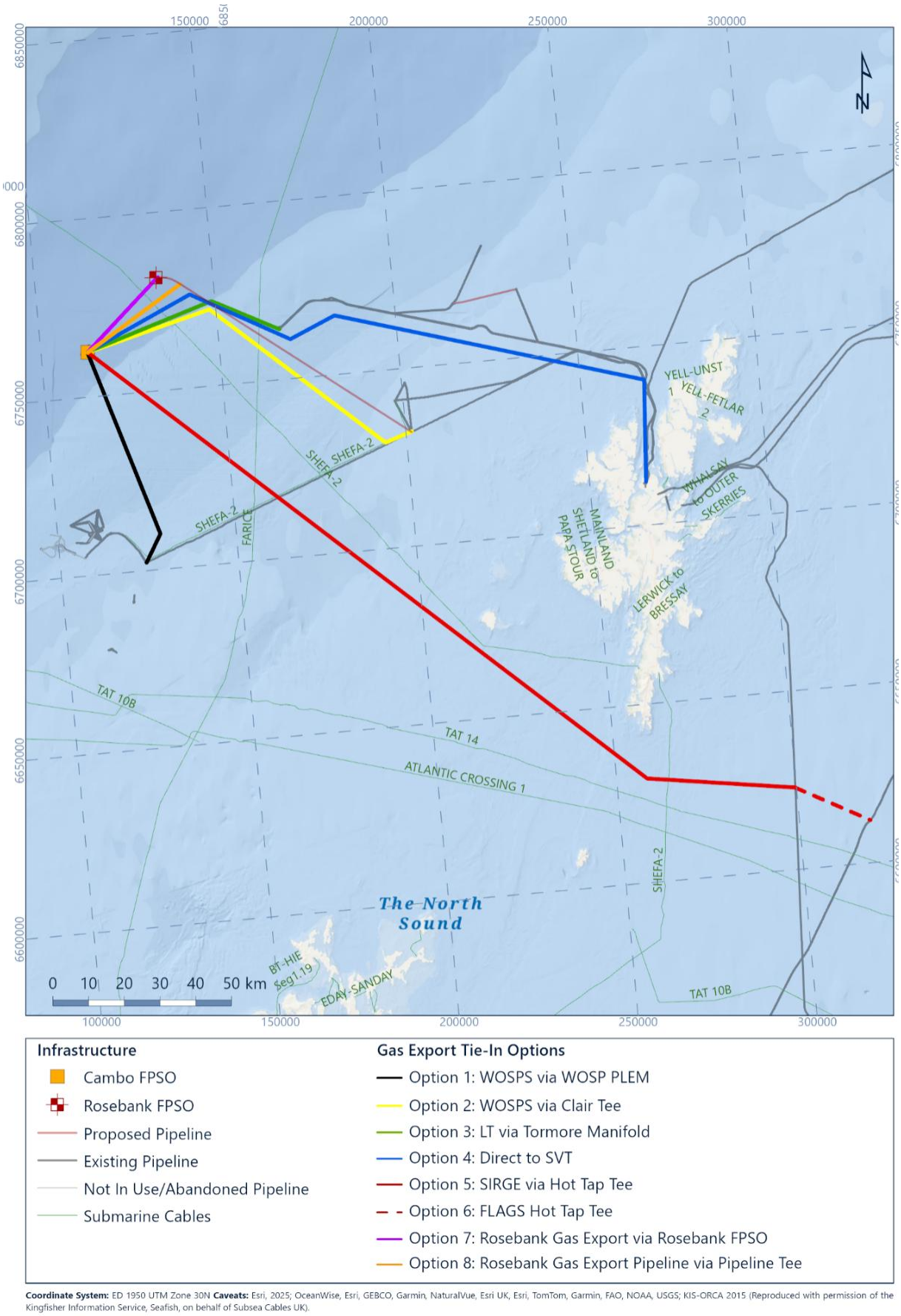
Ithaca Energy considered several possible tie-in options for a gas export pipeline route within a nominal 300 km radius from the Cambo field (Figure 3.24). The basic philosophy in identifying a suitable export route was to avoid the unnecessary proliferation of new pipeline infrastructure as far as practicable by identifying and considering the full range of existing host options.

A screening exercise was undertaken to compare the options and test feasibility. Technical criteria considered when evaluating the options included, routing and installation, tie-in method, export host system, cost and long-term security of supply.

Key environmental considerations considered during the route selection process included the geometric features associated with all routes; the primary feature being the Continental Shelf to the Faroe-Shetland basin, soils, flora / fauna, existing pipelines / cables and approaches to the tie-in points. In addition, installation of the export pipeline considered specific aspects and areas of potential risk, including environmental issues (pipeline route options cross the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA), see Section 5.6.2), pipelay operations and trenching risks.

All route options were developed to cross the Continental Shelf at right angles to minimise their length within the NCMPA.

Based on infrastructure existing in the area, six initial tie-in options were identified for Cambo gas export (distances are based on the proposed routes from Cambo).



Coordinate System: ED 1950 UTM Zone 30N **Caveats:** Esri, 2025; OceanWise, Esri, GEBCO, Garmin, NaturalVue, Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS; KIS-ORCA 2015 (Reproduced with permission of the Kingfisher Information Service, Seafish, on behalf of Subsea Cables UK).

Figure 3.24: Gas export tie-in options

Option 1: West of Shetland Pipeline (WOSPS) via the WOSPS Pipeline End Manifold (PLEM) (65 km)

This route involves short distances on the basin floor and on the Continental Shelf with most of the length being over the continental slope. A direct pipeline route would feature approximately 25 km on the floor of the Faroe-Shetland Channel, after which the seafloor rises over approximately 40 km to the continental shelf at 200 m water depth.

Relatively minor deviations to the route would be required to this host, primarily to avoid geometric features associated with the slope area. No major installation issues are envisaged, and it is expected that the pipeline could be trenched up to 800 m water depth if required.

Option 2: WOSPS via Clair Tee (117 km)

This route involves running the pipeline in a north easterly direction parallel to the ridge (and Faroe-Shetland Sponge Belt NCMPA) until a route at right angles to the slope can be reached (a straight-line route between Cambo and the Clair Tee would comprise a significantly larger portion of the NCMPA).

The pipeline is assumed to be trenched and backfilled in shallow waters, over approximately 50 km. The risk of boulders and rock outcrops could necessitate rock protection at some points along the route and in the Clair Tee area for fishing protection. Two cable crossings are associated with this route: Shetland-Faroe Communication Cable (SHEFA-2) and Faroe-Iceland Communication Cable (FARICE) cable, and a local crossing of a communications cable adjacent to the new tie-in structure.

Option 3: Laggan Tormore Pipeline via Tormore Manifold (65 km)

This route involves crossing the Faroe-Shetland Sponge Belt NCMPA at a shallow angle and would have approximately 30 km of the line within the area, while also crossing the steepest part of the shelf at an oblique angle. The selected case assumes that the pipeline would be laid on the basin floor for approximately 40 km before turning south easterly towards Tormore, crossing the NCMPA and shelving region at right angles. This dog-leg route would add approximately 10 km to the route length. Two cable crossings are required on this route, the SHEFA-2 and FARICE.

Option 4: Direct to Sullom Voe Terminal (SVT) (190 km)

This route features several obstacles that prevent a direct route. The major feature being the access route in through Yell Sound to the shore approach at Orka Voe.

The pipeline would require an increase in concrete weight coat thickness in the shallower water depths / shore approach and its installation would comprise a significant increase in complexity when compared to other cases. In particular, the shore approach through Yell Sound would be difficult with potential significant environmental issues. A number of crossings would also be required on this route.

Option 5: Shetland Island Regional Gas Export System (SIRGE) pipeline via existing Hot Tap Tee (240 km)

This route is the second furthest tie-in considered with a length of approximately 240 km. Three cable crossings would be required, FARICE, SHEFA-2, and SHEFA-2 (south of Shetland). A pipeline crossing would be needed at the WOSPS. Crossing of the Faroe-Shetland Sponge Belt NCMPA would be almost at right angles minimising length within the area. Trenching and bury is assumed from approximately 300 m water depth to the host location (with crossings) a distance of some 190 km.

The pipeline routes to the Far North Liquids and Associated Gas System (FLAGS) / SIRGE pass through the Seas off Foula Special Protection Area (SPA), to the southwest of Shetland, this area is related to seabird populations. Hard substrate is reported for areas south of the Shetland Island; this could prevent efficient trenching operations.

Option 6: FLAGS Hot Tap Tee (290 km)

This route would involve three cable crossings: FARICE, SHEFA-2 (adjacent to WOSPS) cable, and one, SHEFA-2, south of Shetland. Crossing of the SIRGE pipeline would also be required. The pipeline would require trenching and burying in the shallower waters on the Continental Shelf, over a distance of approximately 240 km. Hard substrates to the south of Shetland may prevent trenching, potentially requiring rock dumping.

Option 7: Rosebank Gas Export Pipeline via Rosebank FPSO (35 km)

This route would be along the floor of the Faroe-Shetland Channel in water depths of approximately 1,100 m. Crossing of the SHEFA-2 communications cable would be required.

Option 8: Rosebank Gas Export Pipeline via Pre-Installed Pipeline Tee (95 km)

This route would be along the floor of the Faroe-Shetland Channel for approximately 32 km in a north easterly direction parallel to, but not within, the Faroe-Shetland Sponge Belt NCMPA. A new tie in structure to the Rosebank gas export system at the Rosebank In Line Tee (ILT). Up to two crossings would be required along this route.

Table 3.13 summarises the results from the screening exercise, which resulted in these options being screened out.

Table 3.13: Rationale summary for rejection of alternative gas export routes

Potential Gas Export Route	Rationale for Rejection
Option 1: WOSPS via the WOSPS PLEM	■ Shorter, more direct pipeline route connections are available; ■ Pipeline route would traverse a NCMPA.
Option 2: WOSPS via Clair Tee	■ Longer pipeline than more direct route to the Rosebank ILT; ■ Modest Cambo gas export rates do not require the additional capacity afforded by lower entry pressures possible at this entry point; ■ Pipeline route would traverse a NCMPA.
Option 3: Laggan Tormore pipeline via Tormore manifold	■ Multiphase system presents operational challenges for both gas export and future gas import; ■ Uncertainty over longevity of Laggan Tormore system.
Option 4: Direct to Sullom Voe Terminal	■ High CAPEX and potential significant environmental impact; ■ Technical challenges with other shore approaches through the Yell Sound; ■ Multiple crossings required.
Option 5: Shetland Island regional gas export system (SIRGE) pipeline via existing Hot Tap Tee	■ High CAPEX and significant environmental impact. ■ Potential requirement for rock placement along the route south of Shetland
Option 6: FLAGS Hot Tap Tee	■ High CAPEX and significant environmental impact. ■ Potential requirement for rock placement along the route south of Shetland
Option 7: Rosebank Gas Export Pipeline via Rosebank FPSO	■ Rosebank ILT already in situ as of June 2025.

Option 8, an approximately 32 km gas export pipeline connecting to the Rosebank gas export pipeline via an ILT, represents the most suitable option for the Cambo gas export pipeline system. This option represents the shortest pipeline route and is one of the simplest to execute as there is a tie-in point available.

Detailed route survey results have determined the most suitable route between the Cambo FPSO and the Rosebank In-Line Tee remains entirely in deepwater (circa 1,100 m) and is outwith the Faroe-Shetland Sponge Belt NCMPA with few sensitive seabed features identified which may be impacted during pipeline installation.

Commercial work is underway to place further arrangements for transportation and processing through the Sweetening Facilities at SVT, the ESP Crossover to SIRGE and through the FUKA pipeline to St Fergus.

✓ **Fate of Produced Gas Decision:** Gas Export by Pipeline to Shore

3.3.5.12 Export Pipeline Protection

Protection of the gas export pipeline to mitigate any risk of damage from fishing gear interaction is not required since the entire route between the Cambo FPSO and Rosebank In-Line Tee lies in water depths of approximately 1,100 m which is deeper than on-bottom fishing operations. The gas export pipeline route will traverse up to two subsea cables with each crossing requiring protection with 6 concrete mattresses.

3.4 Summary

Given the detailed consideration that the options selection process has been through, the development design (detailed in Section 4 Project Description) is considered to present appropriate solutions for the location and environment.

It should be noted that mitigation has been applied where possible to the options selection process through the avoidance of specific sensitive receptors and the application of techniques for dealing with potential impacts.

4. Project Description

This Section contains a detailed description of the selected options described in Section 3 of this Environmental Statement (ES).

4.1 Cambo Field Development Overview

The Cambo field is situated approximately 133 km to the West of the Shetland Islands in water depths between 1,073 m to 1,105 m.

As mentioned in Section 1.1, a number of wells have been drilled to date on the Cambo structure. Well 204/10-1 (Cambo 1) was drilled in 2002, and oil and gas were discovered in late Palaeocene Hildasay Member sands of the Flett Formation. The reservoir has been subdivided into several units from the H10/H20 basal unit to the H70 uppermost part of the Hildasay Member.

The next well penetrating the Cambo structure was Well 204/10-2, drilled in 2004. Located 3.4 km southeast of Cambo 1, this well targeted the Lindisfarne prospect - T38 to T40 aged pre- and intra-basalt sands lying below the Cambo discovery. Although the Lindisfarne target sands were found absent, during penetration of the Cambo reservoir (Hildasay sands), the local Hildasay H30 sand was found to be thin but hydrocarbon bearing with good porosities (21 % to 25 %). The Lower Hildasay sand (H10/20) was also found to be hydrocarbon-bearing.

Well 204/10a-3 was drilled in June 2009 to appraise the Hildasay sands in a down-dip location and also to test the presence of pre- and intra-basalt sand potential. The Hildasay sands were water bearing and were thicker and of better quality than anticipated. An additional thick Upper Hildasay sand (H40/50) was also encountered.

Well 204/10a-4 and its side-track well 4Z were drilled during the summer and autumn of 2011. This appraisal well was drilled to confirm commercial reserves in the Hildasay H30 unit, and to investigate if hydrocarbons were present in other sandstone formations at this location. The pilot well encountered oil bearing H70 to H40 units. The side-track was completed in the H30 unit ready for testing, but the onset of poor weather prevented the test from happening. While the well revealed the extent of hydrocarbons in the Hildasay formation, it failed to find sand or hydrocarbons in the Lower Colsay interval. The well was plugged and abandoned in July 2019.

Appraisal well 204/5a-1 was drilled in 2013 to further evaluate the structure, extent and hydrocarbon bearing potential of the Colsay reservoir, within the Cambo field.

Appraisal well 204/10a-5 was drilled in 2018 and encountered oil-bearing Hildasay sands in units H70, H50, H40 and H30, with gas present in the H10/20 unit. Two whole cores were cut in the H50, H40 and H30 Hildasay units. The subsequent horizontal side-track (204/10a-5Y) was tested and flowed naturally, producing at an average rate of 757 m^3/day (4,762 bopd) during the final 76 hours of flow.

4.2 Crude Characteristics and Production Rate Forecast

The oil present in the Hildasay reservoir is of varying quality due to a complex fill history. The proposed Cambo field development will target the Hildasay H50/40 and H30 sands. Table 4.1 presents the main oil characteristics of the H50/40 and H30 fluids.

Table 4.1: Cambo oil characteristics

Oil Characteristics	H50/40	H30
Specific gravity	0.916	0.905
Oil Gravity °API	22.8	24.6
GOR (scf / stb)	345	393
Pour point (°C)	-24	-21
Wax content (%)	8.4	10.4
Asphaltene content (%)	0.35	0.35
Viscosity (cP at reservoir conditions)	6.6	4.1

The proposed field development is expected to produce hydrocarbons for circa 25 years. Table 4.2 and Figure 4.1 presents the high-case production profile (at least P_{10}) for the Cambo field. As the low case production profile for oil and gas actually produces the highest volumes of produced water, the low case produced water profile has also been included in the table and figure. All three production profiles, i.e. high case, mid case and low case, are presented in Appendix 5.

Table 4.2: Forecast production from the Cambo field

Year	Oil (High-case)		Gas (High-case)	Water (Low-case)
	m^3/day	Tonnes/day	Sm^3/day	m^3/day
2030	1,292	1,179	111,825	18
2031	6,439	5,872	520,222	760
2032	6,439	5,874	602,472	2,200
2033	6,439	5,875	605,418	4,770
2034	6,439	5,876	535,395	6,286
2035	6,365	5,807	502,578	7,108
2036	5,598	5,107	421,550	7,660
2037	4,622	4,217	342,736	8,041
2038	3,839	3,501	282,655	8,315
2039	3,318	3,027	241,717	8,510
2040	2,937	2,679	215,135	8,585
2041	2,625	2,394	192,325	8,585
2042	2,339	2,133	169,524	8,585
2043	2,100	1,916	148,006	8,585
2044	1,872	1,708	127,998	8,585

Year	Oil (High-case)		Gas (High-case)	Water (Low-case)
	m^3/day	Tonnes/day	Sm^3/day	m^3/day
2045	1,687	1,539	115,253	8,585
2046	1,542	1,406	104,975	8,585
2047	1,426	1,301	97,170	8,585
2048	1,328	1,212	90,941	8,585
2049	1,245	1,136	85,487	8,585
2050	1,173	1,070	80,727	8,585
2051	1,107	1,010	76,051	8,585
2052	1,049	957	71,479	8,585
2053	997	910	67,186	8,585
2054	947	865	63,445	8,585
2055	903	824	60,151	8,585

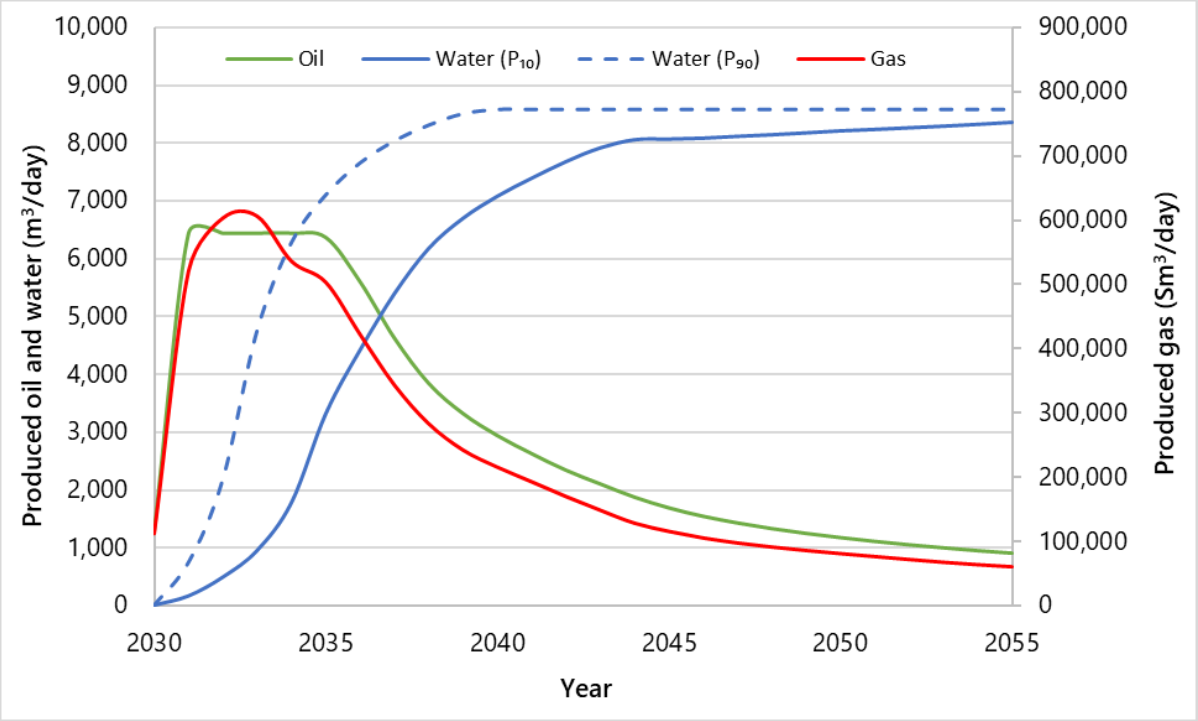


Figure 4.1: Production profile of the proposed Cambo field development

4.3 Project Overview and Schedule

The proposed Cambo field development will comprise nine production wells supported by four peripheral seawater injection wells. For the purpose of this ES, an optional dedicated appraisal well is also considered. All reservoir fluids will be produced via three subsea Drill Centres (DCs) connected to a new-build Floating Production, Storage and Offloading vessel (FPSO), as illustrated in Figure 4.2. The liquid fraction of the produced hydrocarbons (oil) will be offloaded

periodically by oil tanker, with produced gas used as fuel onboard the FPSO. Gas produced in excess of fuel requirements will be exported by pipeline into the Rosebank Gas Export Pipeline (GEP) (subject to commercial negotiations) which, in turn, connects to the West of Shetland Pipeline System (WOSPS) (Section 4.5.2). When Cambo becomes gas deficient this pipeline can also be used to import fuel gas, if required, depending on the production profile and if a reliable economic electrical power source will become available to power the Cambo FPSO.

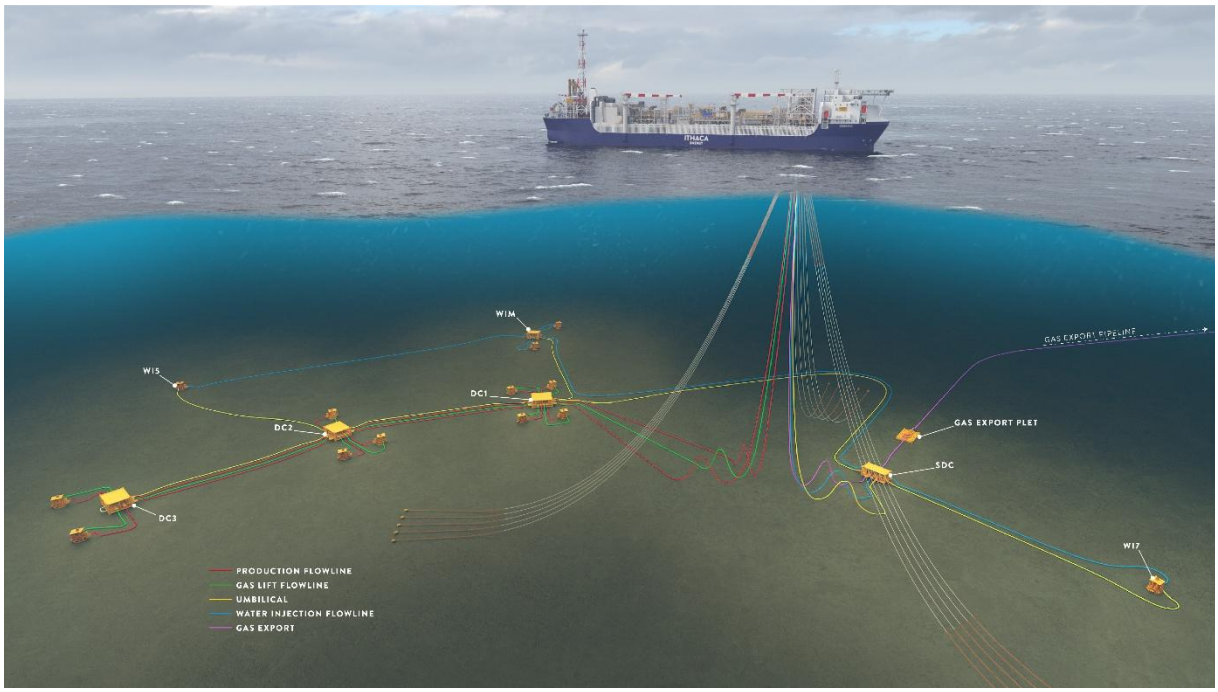


Figure 4.2: Indicative overview of the proposed Cambo field development layout (not to scale)

The Cambo field development is currently in the Front End Engineering Design (FEED) phase of the project life cycle. The following sections provide a description of the current base-case design for the project. Some of the aspects in this project description will be further refined during the detailed design phase and may therefore be subject to change. However, the design parameters presented in this ES are deemed realistic, yet conservative (i.e. realistic worst-case) with regard to the potential environmental impacts, based on the current project understanding.

Table 4.3 provides an indicative overview of the proposed timeline for the drilling and installation phase of the proposed Cambo field development.

Subsea installation will be limited by the summer weather windows. It is anticipated that the FPSO hook-up, pipeline and field commissioning will take up to 6 months. First oil is expected in Q4, 2030.

Table 4.3: Indicative timetable for the proposed Cambo field development

Project Stage	2028				2029				2030			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CAN-ductor Installation												
Drilling and completions												
Gas export pipeline installation												
SPS/SURF installation												
FPSO anchor installation and lower mooring lines												
FPSO upper mooring lines installation												
Xmas tree installation												
SPS/SURF completion and pre-commissioning												
FPSO hook-up and commissioning												
First oil												

Notes
SPS = Subsea Production System
SURF = Subsea Umbilicals, Risers, and Flowlines
FPSO = Floating Production, Storage, Offloading

4.4 Drilling Operations

Nine new production wells and four water injection wells will be drilled at the Cambo field. For the purpose of this ES, it is assumed that an optional dedicated appraisal well will be drilled to assist with the optimisation of the well locations in the southwest of the Cambo field. Figure 4.3 shows the proposed well locations in relation to the Cambo FPSO and its anchor lines. All wells will be drilled using either a dynamically positioned (DP) semi-submersible Mobile Drilling Unit (MODU) or a DP drill ship. There may be a possibility to utilise a second MODU or drill ship during the drilling campaign. This is considered further in Section 4.4.1.

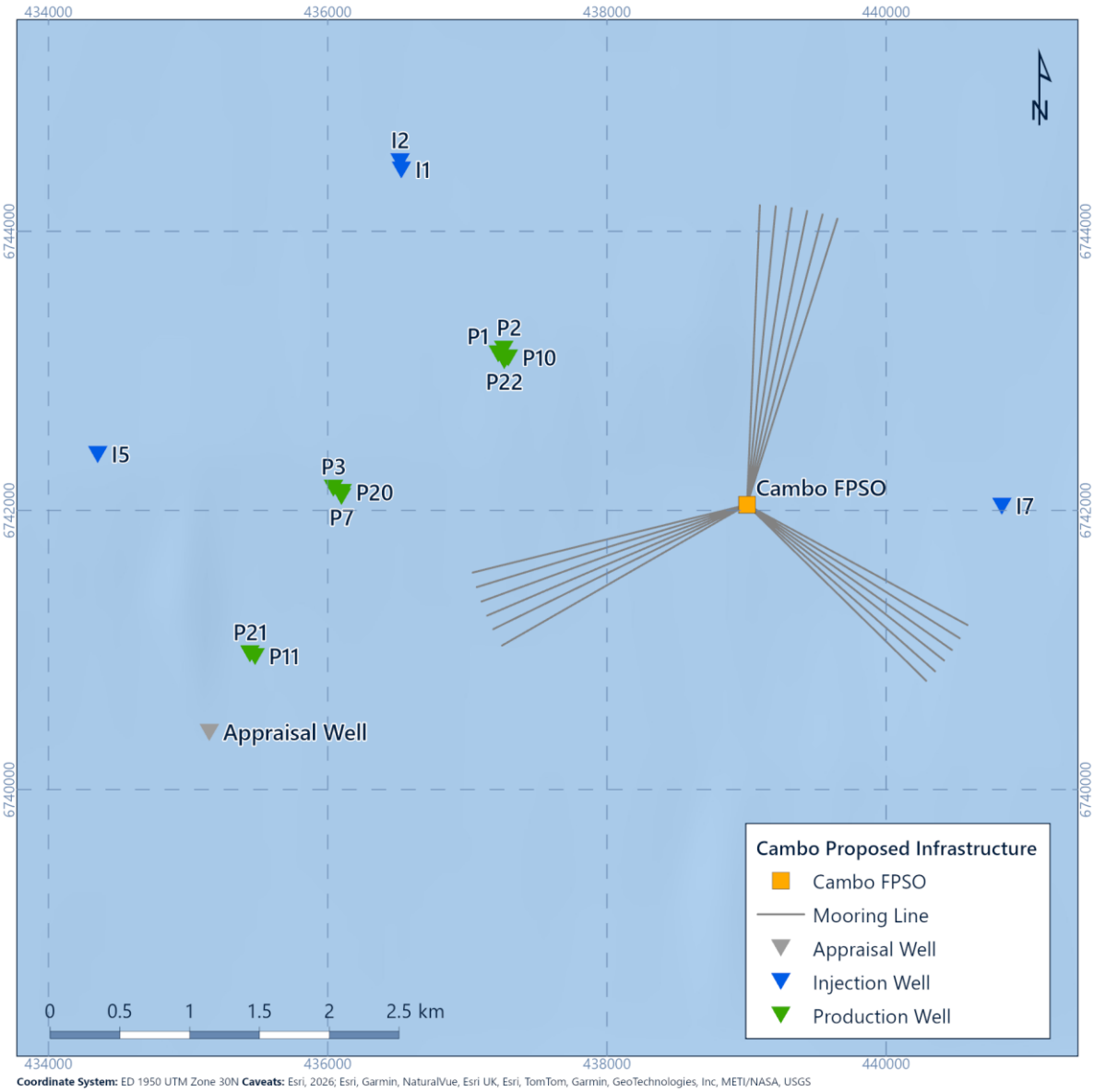


Figure 4.3: Location of proposed wells

The wells will be drilled using a combination of seawater and bentonite sweeps for the top holes, and all cuttings and mud or sweeps will be discharged directly to the seabed after circulating through the well. Following this, a riser will be installed, so that cuttings and muds for the deeper sections of the well will be returned to the MODU. The lower sections of the wells will be drilled using water-based mud (WBM) or low toxicity oil based mud (LTOBM). The wells will be left suspended until the FPSO comes online and the wells will be brought online from 2030 onwards. Once the wells are connected to the FPSO, clean-up will be completed before production commences. The well clean-up operations from the FPSO may require some flaring (Section 4.6.8). By selecting a robust completion design and reliable components, planned interventions (i.e. operations within Ithaca Energy's control, such as production logging or water shut off) or workovers will be infrequent throughout the life of field, and none are currently planned.

Due to the soft upper seabed sediments at the Cambo field, Ithaca Energy plans to use NeoDrill 'Conductor Anchor Nodes' (CAN-ductors) on all Cambo wells. A CAN-ductor was successfully used on the Cambo 204/10a-5Y well in 2018, increasing tophole wellbore stability and reducing overall drilling time. A subsequent geotechnical site survey in 2019 confirmed that seabed conditions at the Cambo 204/10a-5Y well are typical of the seabed conditions in the field development area and verified the suitability of the CAN-ductor technology for the remaining Cambo wells. However, in case of any currently unforeseen circumstances preventing the use of CAN-ductors for any of the proposed wells, conventional tophole sections will be drilled by the MODU instead. For the purposes of this ES, the slightly larger physical footprint of the CAN-ductor has been assessed in the physical presence section as a worst case, whereas the assessment of drill cuttings discharges has been based on the worst-case scenario of drilling all wells with conventional tophole sections.

4.4.1 The Mobile Drilling Unit, Other Vessels and Helicopters

The MODU to be used to drill the Cambo wells has not yet been confirmed, however, it is anticipated to be either a semi-submersible drilling unit or a drillship designed to operate in deepwater harsh environments, such as that present at the Cambo field. It may be possible to accelerate and optimise the project schedule by using an additional semi-submersible or drillship during the summer months, when metocean conditions are generally more favourable. This could potentially significantly reduce the overall amount of drilling days to drill all 14 wells. However, for the purposes of environmental impact assessment it is assumed that only one MODU will be used, to represent the worst-case environmental impact scenario.

Once on location, station-keeping for the MODU will be via a Dynamic Positioning (DP) system. The DP System comprises multiple azimuth thrusters, which are controlled by a computer determining the exact location of the MODU. The thrusters are activated automatically when necessary to maintain the vessel precisely on station.

A typical DP deepwater semi-submersible will have an on-board fuel capacity of around 4,500 m^3 and consumes an average of 45 m^3 (39 tonnes) of fuel per day while drilling. DP drillships generally have a higher onboard fuel capacities. For example, using the 6th generation Stena ICEMAX DP Drill ship as a proxy, the fuel capacity of a drillship will be 15,565 m^3 with a daily fuel consumption of 45 to 50 m^3 (39-44 tonnes) during drilling operations.

In addition to the MODU itself, the drilling operations will require support vessels (supply vessels and a statutory standby vessel) and helicopter transfer of personnel to and from the MODU/drillship during the drilling period. It is estimated that there will be five scheduled helicopter visits to the rig per week. Otherwise, all transport of drilling equipment, supplies, water, fuel and food will be undertaken by supply vessels, which will also return waste and surplus equipment to shore. A supply vessel will visit the MODU/drillship approximately twice per week from the supply base in Aberdeen. The standby vessel will be on station near the MODU/drillship throughout the drilling operations.

Table 4.4 and Table 4.5 show a conservative estimate of fuel consumption from the MODU/drillship and associated support vessels and aircraft for the duration of the proposed drilling and completion operations with and without the use of CAN-ductors (see Section 4.4.2 for more information on CAN-ductors). These estimates include 50 % contingency for weather delays, re-spuds and drilling of sidetracks, if required.

Table 4.4: Vessel requirements for drilling using CAN-ductors for all wells and installation of Xmas trees

Activity	Vessel	Fuel Type	Fuel Consumption Rates	Duration	Total Fuel Consumption [Tonnes]
Drilling wells (excluding tophole sections – Assumes CAN-Ductors are used on all wells)	DP MODU	Marine Diesel	44 tonnes/day	1,127 days	49,588
Support Shipping	Supply vessels	Marine Diesel	10 tonnes/day	644 days	6,440
Support Shipping	Standby vessel	Marine Diesel	6 tonnes/day	1,127 days	6,762
Installation of CAN-ductors	CSV	Marine Diesel	22 tonnes/day	40 days	880
Installation of Xmas Trees	CSV	Marine Diesel	22 tonnes/day	45 days	990
Total Diesel Consumption					**64,660**
Personnel transport	Helicopter	Aviation fuel	0.7 tonnes / Return flight	805 round trips	564

Table 4.5: Vessel requirements during conventional drilling and installation of Xmas trees (no CAN-ductors)

Activity	Vessel	Fuel Type	Consumption Rates	Duration	Total Fuel Consumption [Tonnes]
Drilling wells (including tophole sections)	DP MODU	Marine Diesel	44 tonnes/day	1,214 days	53,416
Support Shipping	Supply vessels	Marine Diesel	8 tonnes/day	694 days	5,552
Support Shipping	Standby vessel	Marine Diesel	6 tonnes/day	1,214 days	1,821
Installation of Xmas Trees	CSV	Marine Diesel	22 tonnes/day	45 days	990
Total Diesel Consumption					**68,630**
Personnel transport	Helicopter	Aviation fuel	0.7 tonnes / Return flight	867 flights	607

4.4.2 Well Engineering

All production wells will be of very similar design as that indicated in Figure 4.4, with a long high angle/near horizontal reservoir sections to maximise production rates and limit the required well count. The proposed casing design for the Cambo wells will follow a proven design that has been used on the previous Cambo wells, for example well 204/10a-5Y, and is seen as the most efficient design to safely execute the well. The optional appraisal and injection wells will follow a similar design to the production wells and will also be high angle single bore wells.

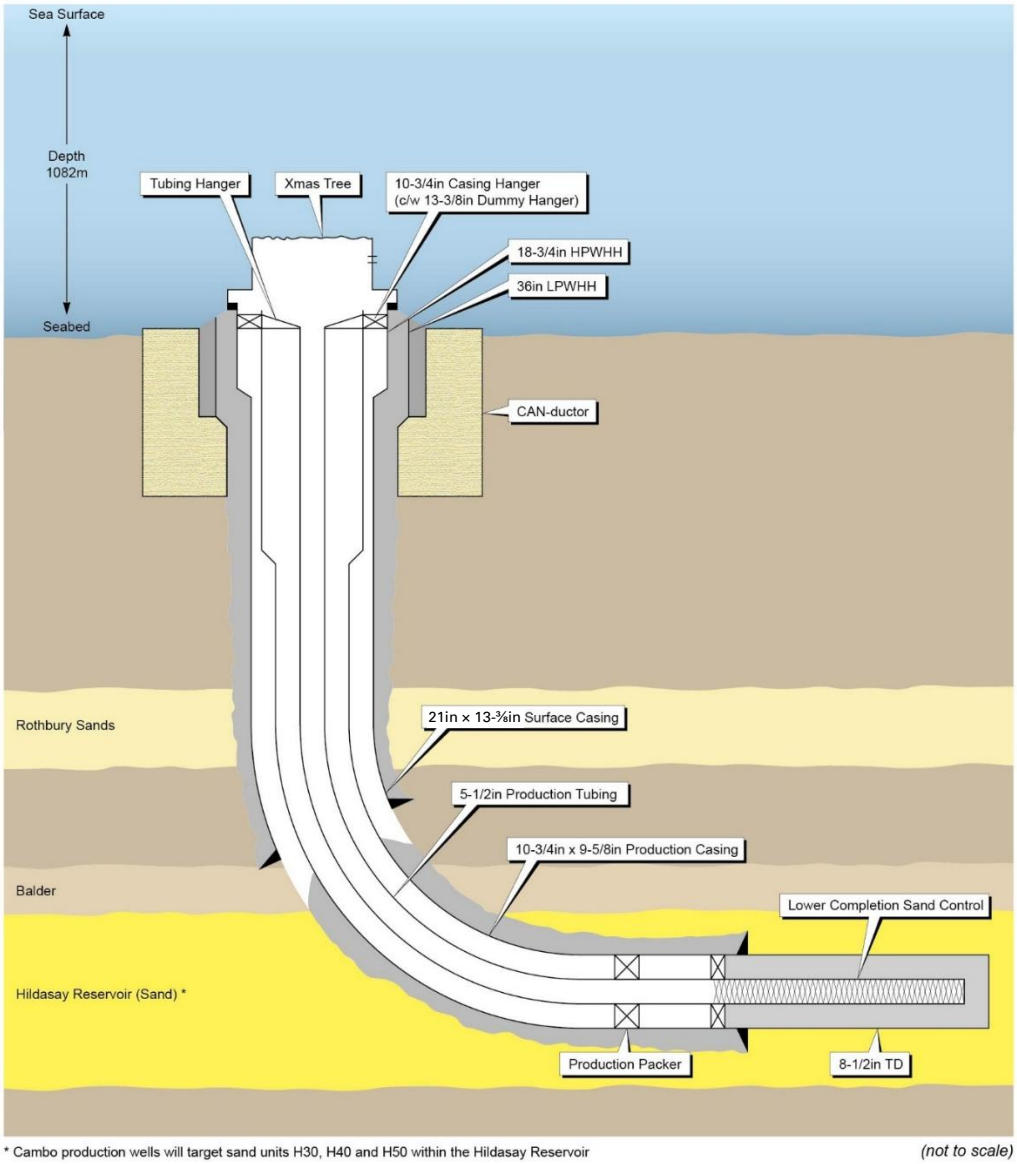


Figure 4.4: Proposed well design

A batch drilling and completion approach has been selected to drill the wells. This means that the tophole sections of the wells will be drilled in succession with a likely maximum of a batch of four wells at any one time. The deeper well sections that require a marine riser to be installed,

can then be drilled efficiently with the Blowout Preventer (BOP) being hopped between wells. This approach will optimise operations and reduce the overall duration of the campaign.

As mentioned in Section 4.4, Ithaca Energy plans to use CAN-ductors on the Cambo wells. The CAN-ductor is a pre-rig stage well construction technology designed to replace a conventional tophole section and associated conductor (Figure 4.5). The CAN-ductors will be pre-installed into the seabed before the drilling rig arrives.

The CAN-ductor is a specially designed cylindrical suction anchor containing an integrated continuous conductor pipe. The outer structure is approximately 17.5 m long, with a 6 m diameter and a surface area of 28.3 m^2. The CAN-ductors will be transported and installed from a high capacity construction support vessel (CSV) before the MODU arrives. The CAN-ductor is placed on the seabed via a crane and allowed to partly self-penetrate the seabed under its own weight. A pump, based on a remotely operated vehicle (ROV) is then connected to the CAN-ductor via a hot-stab. The ROV pumps water out of the can, creating negative pressure within it, sucking the remaining extent of the CAN-ductor into the seabed. Once the top of the CAN-ductor is no more than 1 m above the seabed, with the integrated conductor pipe projecting roughly 2 m above the sediment surface (Figure 4.6), the lifting gear is released by the ROV and recovered to the vessel.

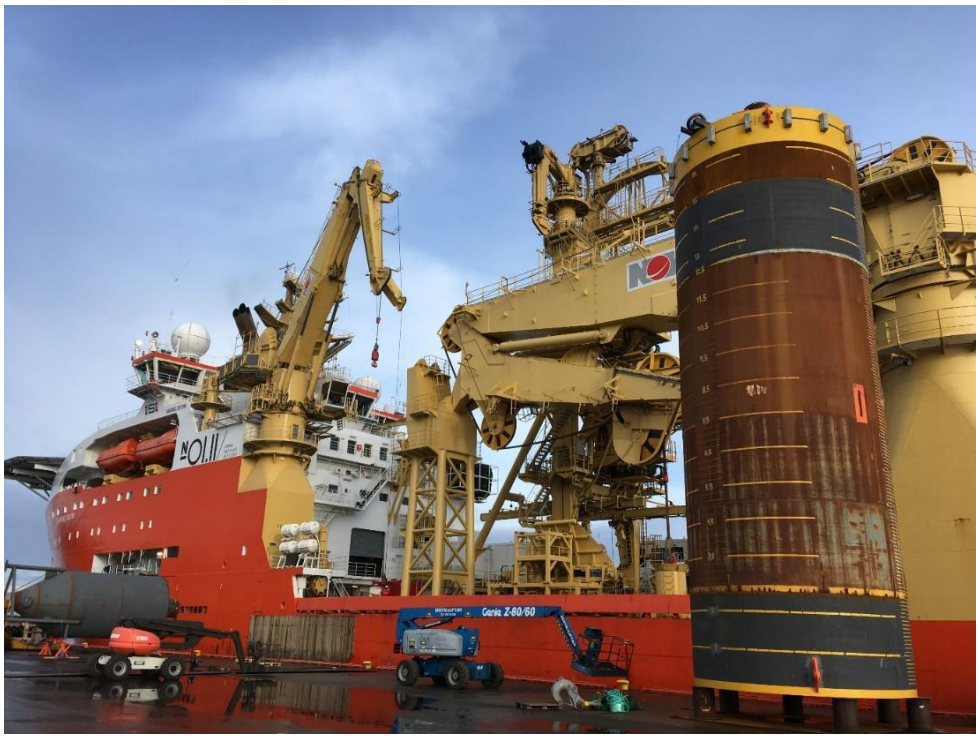


Figure 4.5: CAN-ductor for the previously drilled Cambo 5Y well on the quayside, awaiting deployment

Figure 4.6: CAN-ductor for the previously drilled Cambo 5Y well installed on the seabed

The pre-drilling installation of the CAN-ductor effectively installs the initial tophole and conductor sections without the need for a MODU, providing support in soft seabed sediments as well as increased horizontal stability, verified load capacity and improved fatigue management. This removes the need for tophole drilling, conductor installation and subsequent cementing operations. Consequently, if CAN-ductors are used there will be no discharge of cuttings and excess cement at the seabed in relation to the first section of each well. The CAN-ductor must be installed well in advance of the actual drilling operations to allow surrounding sediments to re-stabilise, providing a structurally sound basis for installation of the BOP and running of other well structures.

If the wells are drilled conventionally (i.e. without CAN-ductor) however, then the first step in the sequence of activities will be to drill the 36" diameter top-hole section into the seabed, into which the 30" diameter conductor pipe is cemented. The second (17½") section will then be drilled through the conductor. A 13⅜" casing string with a high-pressure wellhead housing will then be installed inside the conductor to provide stability to the well and prevent the flow of fluids from the well into the surrounding formations. The conductor and surface casing will provide a firm foundation for the BOP, which will be installed on the drilling riser at the seabed. The drilling riser connects the well to the MODU, therefore providing a conduit to return the mud and cuttings from the deeper sections of the well back up to the MODU.

The deeper 12¼" and 8½" sections of the wells will then be drilled with the drilling fluids circulated back to the MODU. The wells will be completed and left ready for hook up, once the FPSO arrives.

4.4.3 Mud System and Cuttings Discharge

Drilling fluid (or drilling mud as it is commonly known) fulfils a number of functions, such as lubrication and cooling of the drill bit, suspension and transport of rock cuttings to the surface, and the provision of 'weight' (hydrostatic pressure) to counter-balance formation pressure.

Drilling fluids can be categorised on the basis of their principal constituent (in the continuous phase). This continuous phase may be water, oil, synthetic oil or gas. The resulting drilling fluids are called water-based muds (WBMs), oil-based muds (OBMs), synthetic or pseudo-oil based muds (SBMs or POBMs) and foam muds, respectively. Depending upon the type of drilling fluid, the continuous phase may additionally contain dissolved organic and inorganic additives as well as finely divided suspended solids of various types. The type of drilling mud to be used generally depends on the downhole conditions in the well, both anticipated and those encountered in real-time, for which each of these mud types will have certain advantages and disadvantages.

The mud system for the two top sections of the well (36" and 17½") will consist of seawater with high viscosity bentonite sweeps to clean out the borehole. Typically, an 8 m^3 (50 bbl) sweep for every 9 m to 14 m (30 ft to 45 ft) drilled is adequate for hole cleaning, but the frequency and volume of the sweeps will be determined by the hole conditions. The well will be displaced with bentonite mud before installation of the casings.

The deeper 12¼" and 8½" sections of each well will be drilled after the BOP and the marine riser have been installed, using a full WBM or LTOBM system. The mud will be pumped down the drill string to the drill bit and then circulated back to the surface via the annulus (the space between the drill string and the wall of the bore hole), through the BOP stack and the drilling riser back to the MODU. Back onboard the MODU, the mud and cuttings from these sections will pass through a mud recovery system to recover as much of the drilling mud as possible. Once reconditioned, this mud will be used again, thereby minimising the amount of drilling mud used. Eventually all cuttings and spent WBM will be discharged to sea, which is in line with the regulations and is general practice on the UKCS and elsewhere in the world.

Any cuttings contaminated with LTOBM are also not allowed to be discharged to sea, unless they contain less than 1 % oil (in weight) on them. Therefore, any LTOBM contaminated cuttings will either be contained and shipped to shore for appropriate treatment and disposal or, alternatively, will be thermally treated offshore and disposed to sea, depending on the availability of a suitable drilling unit at the time of drilling and whether the MODU can accommodate the thermal treating equipment. The offshore thermal treatment of LTOBM will typically successfully reduce any remaining oil residue on the contaminated cuttings to well below the 1 % discharge threshold, so they can be discharged to sea after treatment. If the offshore thermal treatment option is not available, all LTOBM cuttings will be collected onboard the MODU and shipped back to shore for appropriate disposal.

An estimate of the maximum potential quantity of cuttings generated and WBM used and discharged from the largest production well (P10) is presented in Table 4.6. An estimate of the quantity of cuttings generated and WBM used and discharged from the optional appraisal well is presented in Table 4.7.

For both wells, 12¼" and 8½" contingency sidetracks have been included to represent the potential absolute worst-case discharge scenario. This information has been used to inform

the modelling study on drilling discharges (Section 10). The impact assessment will also take into account the potential for having to re-spud the well, by having to redrill the 36" and 17½" tophole sections of the well (Table 4.8).

Table 4.6: Cuttings and WBM volumes for the largest production well (P10)

Section	Discharge Point	Section Length [m]	Section Volume [m^3]	Cuttings Generated [Tonnes]	WBM Discharged [Tonnes]
36"	Seabed	90	59	133	193
17½"	Seabed	641	99	224	399
12¼"	Surface	2,062	157	353	1,002
12¼" (Contingency sidetrack)	Surface	2,062	157	353	1,002
8½"	Surface	500	23	52	594
8½" (Contingency sidetrack)	Surface	500	23	52	594
Total				**1,167**	**3,784**

Table 4.7: Cuttings and WBM volumes for the optional appraisal well

Section	Discharge Point	Section Length [m]	Section Volume [m3]	Cuttings Generated [Tonnes]	WBM Discharged [Tonnes]
36"	Seabed	90	59	133	193
17½"	Seabed	641	99	224	399
12¼"	Surface	2,062	157	353	1,002
12¼" (Planned sidetrack)	Surface	2,062	157	353	1,002
12¼" (Contingency sidetrack)	Surface	2,062	157	353	1,002
8½"	Surface	500	23	52	594
8½" (Planned sidetrack)	Surface	500	23	52	594
8½" (Contingency sidetrack)	Surface	500	23	52	594
Total				**1,572**	**5,380**

Table 4.8: Cuttings and WBM volumes for re-spudding any of the wells

Section	Discharge Point	Section Length [m]	Section Volume [m3]	Cuttings Generated [Tonnes]	WBM Discharged [Tonnes]
36"	Seabed	90	59	133	193
17½"	Seabed	641	99	224	399
Total				**357**	**592**

The tables above represent the theoretical maximum amounts of cuttings and drilling fluids to be discharged to sea, under worst-case drilling conditions, without the use of CAN-ductors and with all cuttings and WBMs being discharged to sea. Based on these very conservative assumptions, the overall maximum discharge for all 14 wells would be up to 21,384 tonnes of cuttings and 62,268 tonnes of WBM. These estimates include re-spudding and drilling contingency side-tracks on all wells, thus representing the theoretical absolute worst-case discharge scenario, for environmental impact assessment purposes only.

4.4.4 Cementing Operations Chemicals

The casings used to prevent the well from collapsing will be cemented into place inside the borehole. The wells at the Cambo field development will be drilled using a CAN-ductor however there may be operational reasons where a CAN-ductor cannot be used. Consequently, the cementing programme and associated discharges will be different depending on whether a CAN-ductor is used or not.

4.4.4.1 Cementing Operations Chemicals – With a CAN-ductor

If a CAN-ductor is used, the conductor will already have been cemented into the CAN-ductor onshore, and hence there will be no offshore cementing discharges from the first tophole section. The 21" × 13⅜" casing will be cemented through the CAN-ductor. The cement will be pumped down the casing string and forced back up to the (seabed) surface through the annulus. This will typically lead to a certain amount of cement used being squeezed out of the top of the well and discharged to the seabed immediately around the well. For the 21" × 13⅜" casing it is critical to get cement back to the seabed for the structural integrity of the well. The slimhole nature of the Cambo well design (i.e. 17½" hole and primarily 13⅜" casing) allows for lower excess cement discharges from the smaller casing strings, as the washed out cement will be a smaller fraction of the overall volume. Therefore, 50 % excess cement of the open hole volume for the conductor will be used to ensure that the space between the casing and the wellbore is completely filled with cement to ensure the integrity of the well. In theory, this could result in up to 22.7 m^3 (143 bbls) of cement slurry being discharged per well, containing approximately 12.6 tonnes of dry bulk cement. However, the actual amount discharged will be much smaller, as the actual wellbore diameter will be larger than the wellbore gauge diameter (i.e. the diameter of the size of the drill bit), due to hole wash out caused by the drilling muds. In fact, that is the reason why the excess cement is required.

4.4.4.2 Cementing Operations Chemicals – Without a CAN-ductor

On any well where a CAN-ductor cannot be used, the conductor will be cemented into the tophole section of the well. In this case an allowance will be made to pump up to 300 % excess cement to allow for washout and cratering of the wellbore. However, a ROV will monitor the return flow at the seabed and all attempts will be made to identify returns and reduce the pumped slurry volume when possible and safe to do so. A dye will be added to the cement spacer to assist in visually identifying the returns from the wellhead in this case. At this point the remaining cement in the drill string will have to be circulated out, and it is estimated this may result in a discharge of 20.7 m^3 (130 bbls) of cement being discharged at the seabed per well. The cementing of the 21" × 13⅜" casings will be very similar to that of the CAN-ductor option, using 50 % open hole excess cement, which will amount to a theoretical maximum of 20.4 m^3 (128.5 bbls) of mixed cement being discharged onto the seabed. Hence, up to 41.1 m^3 cement slurry (made up of 22.9 tonnes of dry bulk cement) may be discharged at the seabed per well. However, as explained above, this will be significantly less in reality.

The cementing of the 10¾" × 9⅝" casings for the deeper well sections will be engineered so that the cement will not reach to top of the casing, and thus no cement is expected to be returned to the surface from these sections. Hence, there is no planned discharge of any cement from this part of the cementing operations. The only potential cement discharge during this part of the well, would be from an unplanned event, such as an aborted cement job due to technical or mechanical failures if using a WBM system. Under such circumstances any cement circulated back to the MODU would be discharged to sea before it solidifies. If this section is drilled with LTOBM instead however, this cement will not be discharged, but shipped back to shore instead. In the latter case, sugar will be added to retard the setting of the cement. No unmixed cement will be discharged overboard.

4.4.5 Chemical additives used during drilling cementing operations

The specific chemicals and additives used during drilling and cementing will be dependent upon the mud and cement composition, which in turn will be determined by the down-hole conditions encountered whilst drilling. All chemicals will be selected on their technical specifications but will also be assessed on their potential environmental impacts, using the regulatory Harmonised Offshore Chemical Notification System (HOCNS) incorporating the Chemical Hazard Assessment and Risk Management (CHARM) model, where applicable. Additional permitted chemical additives will be stored on the rig to deal with any contingencies such as a stuck drill pipe or loss of circulation. All chemicals to be used in the drilling of the Cambo wells will be detailed in a Chemical Permit Subsidiary Application Templates (CP-SATs), to be submitted via the Portal Environmental Tracking System (PETS) on the online UK Energy Portal, as part of the well consenting process.

During the drilling of the Cambo wells, waste will be generated both due to operational activities (e.g. cements and chemicals), and due to everyday running of the MODU (food waste, water, sewage). All hazardous and non-hazardous waste generated on the MODU and support

vessels will be segregated, and either discharged in line with the requirements of the MARPOL Convention (where appropriate) or returned to shore and disposed of appropriately.

4.5 Subsea Infrastructure

The infield subsea infrastructure for the proposed Cambo field development (Figure 4.2) comprises three DCs with close-clustered production wells (four at DC1, three at DC2 and two at DC3). The wells will be manifolded and tied back to the FPSO. Four water injection wells will be drilled on the flanks of the field.

A schematic of the in-field subsea infrastructure is shown in Figure 4.7

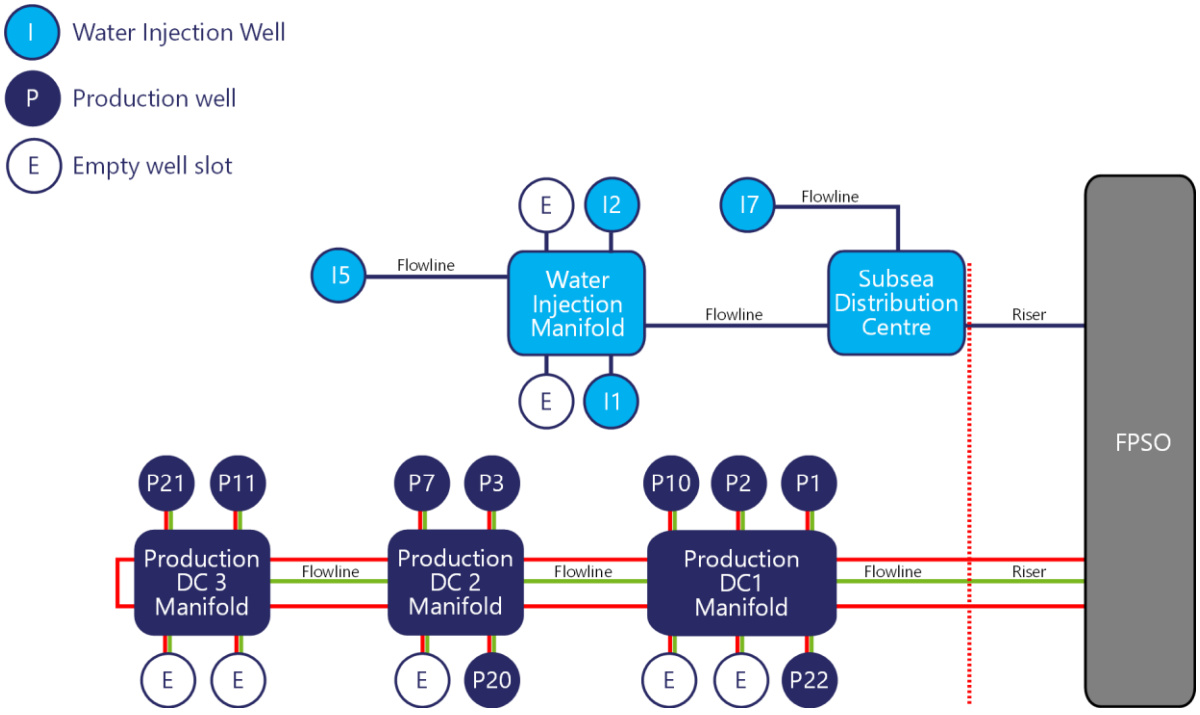


Figure 4.7: Subsea schematic of the proposed Cambo field development

4.5.1 Infield Subsea Infrastructure

The infield subsea infrastructure, including the Xmas trees, manifolds, subsea distribution centre (SDC), water injection manifold (WIM), jumpers, infield flowlines, umbilicals and risers will be installed using DP construction support vessels (CSVs) with ROV capability.

The local water depth and the lazy-wave design of the risers precludes the SDC and Pipeline End Termination (PLET) to be located within the FPSO's nominal 500 m safety zone, as shown in Figure 4.11 in Section 4.6.3 below. However, as they are within the FPSO anchor pattern, a separate 500 m zone specifically for these structures is not anticipated.

4.5.1.1 Trees, Manifolds and Riser-clamp Anchors

Subsea vertical Xmas trees (a set of valves, spools and fittings connected to the top of a well) will be installed on the wellheads from a subsea construction vessel. The Xmas trees form the

main barrier to the reservoir and provide the means for flow control, monitoring and well entry. An example of a typical subsea Xmas tree is shown in Figure 4.8. The production trees are provided with remote connections for both production and lift gas. All wells will be provided with surface-controlled subsurface safety valves which will fail safe close to isolate the reservoir in the event of an emergency.

Fishing intensity studies have indicated that there is no fishing activity in the Cambo in-field area. On this basis, and as exclusion zones will be established around the wells and in-field infrastructure, there are no wellhead protection structures planned. The Xmas trees on top of the CAN-ductors will be 4.4 m × 2.8 m, 4.2 m high and weigh around 60 tonnes each. As the Xmas tree will be installed on top of the CAN-ductors, they will not have an individual seabed footprint, in addition to the seabed footprint of the CAN-ductors.

Figure 4.8: Example of a typical Xmas tree

The DC production manifolds, water injection manifolds and SDC will be installed atop of dedicated foundation structures. The proposed riser configuration is a restrained lazy-wave layout (see Figure 3.3; Section 3.2.5.2), with buoyancy modules installed at the appropriate locations. Each individual riser and umbilical will be tethered to the seabed via hold down tether-clamp systems to reduce movement and fatigue in operation.

Table 4.9 presents an overview of the physical footprint on the seabed of the well heads (i.e. the CAN-ductors), production manifolds, WIMs, and riser tether-clamp anchors. The wellhead footprints are based on using CAN-ductors for all wells, resulting in the largest potential footprint on the seabed.

Table 4.9: Indicative locations and seabed footprints of permanent infield subsea structures

Asset Type	Identifier	UTM E [m]	UTM N [m]	(Diameter / L×W) [m]	Footprint on Seabed [m^2]
Wellhead/CAN-ductor	P1	437,219	6,743,272	6	28.3
Wellhead/CAN-ductor	P10	437,262	6,743,223	6	28.3
Wellhead/CAN-ductor	P2	437,258	6,743,305	6	28.3
Wellhead/CAN-ductor	P22	437,291	6,743,243	6	28.3
Wellhead/CAN-ductor	P11	435,477	6,741,103	6	28.3
Wellhead/CAN-ductor	P20	436,100	6,742,278	6	28.3
Wellhead/CAN-ductor	P21	435,440	6,741,123	6	28.3
Wellhead/CAN-ductor	P3	436,038	6,742,309	6	28.3
Wellhead/CAN-ductor	P7	436,096	6,742,250	6	28.3
Wellhead/CAN-ductor	I1	436,525	6,744,589	6	28.3
Wellhead/CAN-ductor	I2	436,515	6,744,648	6	28.3
Wellhead/CAN-ductor	I5	434,350	6,742,550	6	28.3
Wellhead/CAN-ductor	I7	440,826	6,742,180	6	28.3
Wellhead/CAN-ductor	Optional Appraisal	435,149	6,740,560	6	28.3
DC1 structure	DC1	437,263	6,743,269	17 × 13	221
DC2 structure	DC2	436,065	6,742,282	15 × 13	195
DC3 structure	DC3	435,475	6,741,150	15 × 13	195
SDC structure	SDC	439,550	6,742,825	14 × 10	140
Water Injection Manifold (4 slot) foundation structure anchor	WIM1	436,496	6,744,614	16 × 10	160
Riser tether-clamp anchor - Production flowline 1	RTCA1	438,800	6,742,594	6	28.3
Riser tether-clamp anchor - Production flowline 2	RTCA2	438,591	6,742,369	6	28.3
Riser tether-clamp anchor - Gas lift flowline	RTCA3	438,660	6,742,517	6	28.3
Riser tether-clamp anchor - Water Injection flowline	RTCA4	439,354	6,742,471	6	28.3
Riser tether-clamp anchor - Control Umbilical	RTCA5	439,493	6,742,400	6	28.3
Riser tether-clamp anchor - Gas Export	RTCA6	439,282	6,742,570	6	28.3
Riser hold-back-clamp anchor - Production flowline 1	RHCA1	438,697	6,742,798	6	28.3
Riser hold-back-clamp anchor - Production flowline 2	RHCA2	438,381	6,742,456	6	28.3
Riser hold-back-clamp anchor - Gas lift flowline	RHCA3	438,507	6,742,659	4	12.6

Asset Type	Identifier	UTM E [m]	UTM N [m]	(Diameter / L×W) [m]	Footprint on Seabed [m^2]
Riser hold-back-clamp anchor - Water Injection flowline	RHCA4	439,535	6,742,610	4	12.6
Riser hold-back-clamp anchor - Control Umbilical	RHCA5	439,581	6,742,436	4	12.6
Riser hold-back-clamp anchor - Gas Export	RHCA6	439,408	6,742,734	4	12.6
FPSO Anchor pile 1	AP01	439,092	6,744,348	7.5	44.2
FPSO Anchor pile 2	AP02	439,206	6,744,340	7.5	44.2
FPSO Anchor pile 3	AP03	439,320	6,744,326	7.5	44.2
FPSO Anchor pile 4	AP04	439,430	6,744,306	7.5	44.2
FPSO Anchor pile 5	AP05	439,541	6,744,281	7.5	44.2
FPSO Anchor pile 6	AP06	439,647	6,744,250	7.5	44.2
FPSO Anchor pile 7	AP07	440,580	6,741,338	7.5	44.2
FPSO Anchor pile 8	AP08	440,524	6,741,243	7.5	44.2
FPSO Anchor pile 9	AP09	440,468	6,741,159	7.5	44.2
FPSO Anchor pile 10	AP10	440,412	6,741,084	7.5	44.2
FPSO Anchor pile 11	AP11	440,347	6,741,007	7.5	44.2
FPSO Anchor pile 12	AP12	440,284	6,740,939	7.5	44.2
FPSO Anchor pile 13	AP13	437,244	6,741,191	7.5	44.2
FPSO Anchor pile 14	AP14	437,181	6,741,309	7.5	44.2
FPSO Anchor pile 15	AP15	437,137	6,741,405	7.5	44.2
FPSO Anchor pile 16	AP16	437,097	6,741,507	7.5	44.2
FPSO Anchor pile 17	AP17	437,063	6,741,610	7.5	44.2
FPSO Anchor pile 18	AP18	437034.2	6741714	7.5	44.2
Total					**2,379.6**

4.5.1.2 Infield Flowlines, Jumpers, Risers and Umbilicals

The wells will be connected to the production and injection manifolds by short flexible flowline sections, called 'jumpers'. The manifolds, in turn, will be tied back to the FPSO via flexible flowlines and 'risers' (i.e. flexible pipeline sections between the seabed and the FPSO). Power, controls and chemicals will be distributed to the subsea system via umbilicals (each comprising a static seabed section and a dynamic riser section).

Two umbilicals and one water injection flowline will require to cross an existing subsea cable. Each cable crossing will be protected with 6 concrete mattresses (i.e. 18 concrete mattresses for all three crossings).

Table 4.10 provides details and totals for the footprint for all in-field umbilicals, risers and flowlines and associated protection.

Table 4.10: Seabed footprint of all infield umbilicals, risers and flowlines

Line Type	UTM E [m] / Start Point	UTM N [m] / End Point	Length [m]	Installation Width [m]	Total [m^2]
Production jumpers	P11, P21	DC3	70 (×2)	0.357	50.0
Gas lift jumpers	P11, P21	DC3	70 (×2)	0.100	14.0
Xmas tree control umbilicals	P11, P21	DC3	70 (×2)	0.160	22.4
Production flowline 1	DC3	DC2	1,275	0.475	605.6
Production flowline 2	DC3	DC2	1,275	0.475	605.6
Gas lift flowline	DC3	DC2	1,271	0.232	294.9
Control umbilical	DC3	DC2	1,275	0.164	209.1
Production jumpers	P3, P7, P20	DC2	70 (×3)	0.357	75.0
Gas lift jumpers	P3, P7, P21	DC2	70 (×3)	0.100	21.0
Xmas tree control umbilicals	P3, P7, P22	DC2	70 (×3)	0.160	33.6
Production flowline 1	DC2	DC1	1,577	0.475	749.1
Production flowline 2	DC2	DC1	1,553	0.475	737.7
Gas lift flowline	DC2	DC1	1,565	0.232	363.1
Control umbilical	DC2	DC1	1,586	0.164	260.1
Production jumpers	P1, P2, P10, P22	DC1	70 (×4)	0.475	133.0
Gas lift jumpers	P1, P2, P10, P22	DC1	70 (×4)	0.100	28.0
Xmas tree control umbilicals	P1, P2, P10, P22	DC1	70 (×4)	0.160	44.8
Production flowline 1	DC1	Touch down	1,958	0.475	930.1
Production flowline 2	DC1	Touch down	1,894	0.475	899.7
Gas lift flowline	DC1	Touch down	2,133	0.232	494.9
Control umbilical	DC1	SDC	4,565	0.164	748.7
Injection flowline	I1, I2	WI manifold	70 (×2)	0.205	28.7
Xmas tree control umbilicals	I1, I2	WI manifold	70 (×2)	0.160	22.4
Injection flowline	I5	WI manifold	3,200	0.375	1,200.0
Control umbilical	I5	DC2	1,750	0.096	168.0
Injection flowline	WI manifold	SDC	5,040	0.375	1,890.0
Injection flowline	I7	SDC	1,453	0.375	544.9
Control umbilical	I7	WI manifold	1,481	0.096	142.2
Injection flowline	SDC	Touch down	528	0.375	198.0
Control umbilical	I1, I2	WI manifold	70 (×2)	0.090	12.6
Control umbilical	WI manifold	DC1	1,684	0.115	193.7
Control umbilical	SDC	Touch down	623	0.164	102.2
Gas export riser	SDC	Touch down	550	0.314	172.7
Gas export jumper	SDC	Cambo PLET	200	0.323	64.6
Cable Crossing 1	436,955	6,744,042	6 (×6)	3	108

Line Type	UTM E [m] / Start Point	UTM N [m] / End Point	Length [m]	Installation Width [m]	Total [m^2]
Cable Crossing 2	437,533	6,744,623	6 (×6)	3	108
Cable Crossing 3	435,308	6,742,384	6 (×6)	3	108
Total					**12,384**

4.5.2 Subsea Installation and Commissioning

For the purposes of this EIA it is assumed that the foundation structures for the SDC, WIMs, and two PLETs (one at each end of the gas export pipeline (GEP)) will be gravity-based, representing the largest potential seabed footprint. During the detailed design stage and based on the geotechnical survey results, alternative foundations, including suction piles or skirted mud mat foundations, will also be considered.

Infield jumpers, flowlines and static umbilicals will be surface laid. Flowlines and umbilicals will be connected to the structures and trees via diverless horizontal connection systems operated by ROV. All connections will be subsequently leak tested and control and chemical injection systems function tested after hook-up to the FPSO.

Details on the vessels involved and the duration of the installation and commissioning activities is provided in Section 4.5.6 below.

4.5.3 SHEFA-2

The Cambo field development shall establish a communications link to shore via radio and satellite systems as the base case configuration. The systems and data transfer capacity shall be sized for transfer of process and facilities data alongside typical day-to-day and emergency communications and notification requirements.

Provision has also been made for optional installation of a fibre optic cable (FOC) linking to the SHEFA-2 fibre communication link that runs between the Shetland Islands and the Faroe Isles located approximately 23 km to the north. A FOC connection shall be provided in the main umbilical riser to provide the future option for tie-in link to the SHEFA-2 communication cable. Subsea and topside connections on the umbilical termination will allow for ease of installation in future. Installation of a subsea FOC remains an optional enhancement for consideration through detailed design.

The FOC would be approximately 23 mm wide and installed from the SDC within the Cambo field to the SHEFA-2 cable. The FOC would be surface laid on the seabed until it connects with the SHEFA-2 cable (Figure 4.11). Table 4.11 summarises the worst-case seabed footprint due to the presence of the FOC.

Table 4.11: Seabed footprint of fibre optic cable

Cable Feature	Cable Length [m]	Cable Width [m]	Total Footprint [m^2]
FOC	23,000	0.023	529
Total			**529**

4.5.4 Gas Export Pipeline and Associated Subsea Infrastructure

The Gas Export Pipeline (GEP) will be carbon steel, uninsulated and without concrete weight coating, as the concept design study shows that given the relatively small diameter of the GEP (8"), it will be stable on the seabed (i.e. will be negatively buoyant).

The GEP will be reel-laid from a pipelay vessel and will take 27 days to complete. The new 32.5 km long GEP (Figure 4.9) will transport produced gas from Cambo to shore via a new tie in structure to the Rosebank gas export system at the Rosebank in line tee (ILT).

The GEP will cross two subsea cables. Each cable crossing will be protected with 6 concrete mattresses (i.e. 12 mattresses for both crossings).

When Cambo becomes gas deficient the GEP can also be used to import fuel gas, if required, depending on the production profile and when electricity will become available to power the Cambo FPSO.

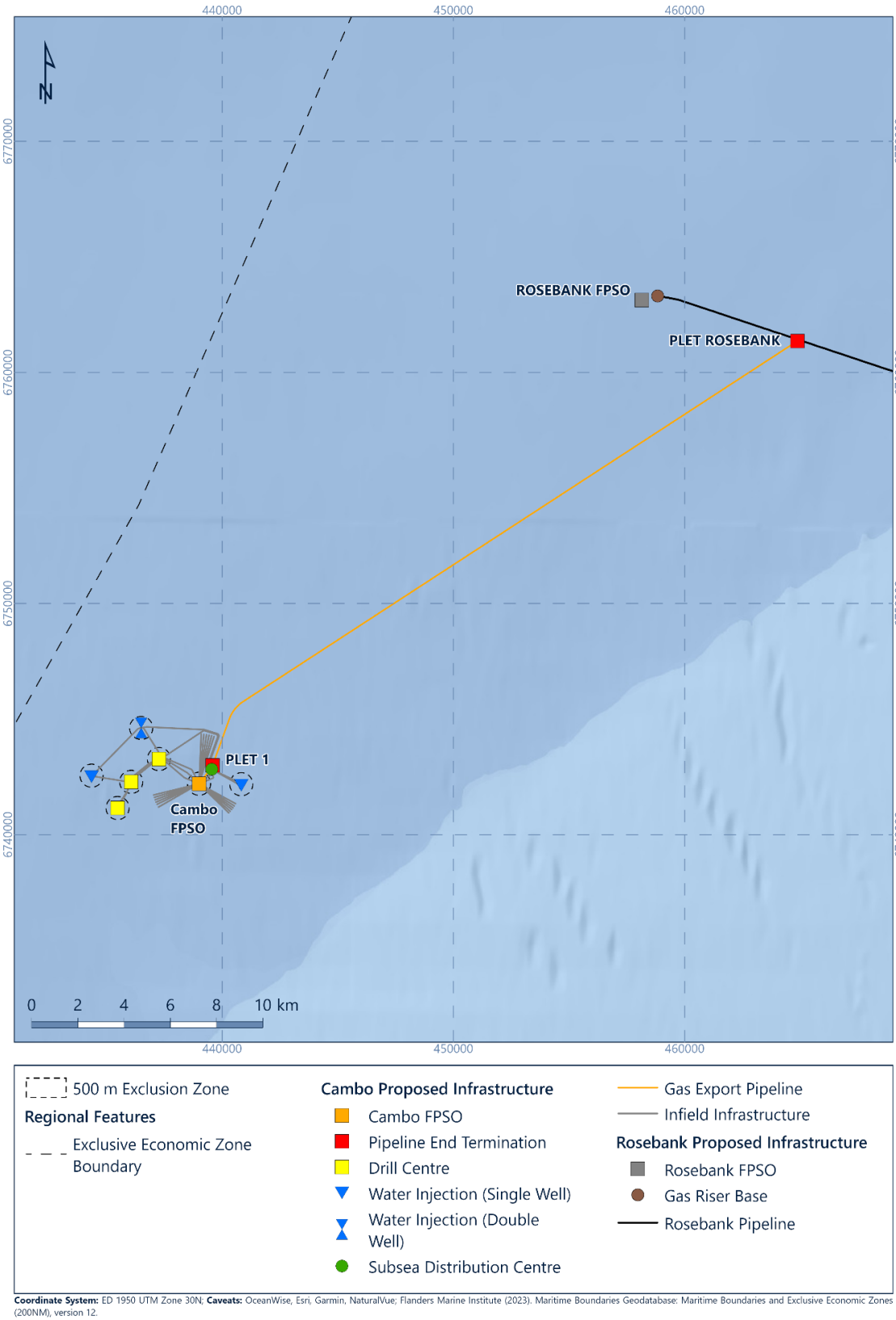


Figure 4.9: Proposed Cambo field development and gas export pipeline to Rosebank

4.5.5 Temporary Seabed Obstructions

In addition to the permanent seabed structures, there will also be a number of temporary obstructions placed on the seabed during the installation phase, as detailed in Table 4.10.

Some of the subsea equipment may be temporarily located on the seabed in areas designated as laydown areas. These laydown areas will be approximately 4 m × 3 m (12 m^2). Up to 20 laydown areas may be required during installation operations.

Two suction anchors will be required to assist in the installation of the FPSOs submerged turret production (STP) buoy and the GEP. These types of anchors are the conventional mooring standard solution for deep-water soft soils (Lloyds Register, 2019).

One suction anchor pile will be used to temporarily secure the FPSO's STP buoy to the seabed before it is connected to the FPSO. This suction anchor pile will be 6 m in diameter and up to 12 m long. Therefore, this suction anchor will temporarily cover an area of seabed approximately 28.3 m^2, for up to 1 year. Once the STP is connected to the FPSO, the suction pile anchor will be retrieved from the seabed.

During the pipeline initiation phase, where the GEP will be first laid on the seabed, a second suction anchor pile, will be installed. The suction anchor for the GEP will be 4 m in diameter and up to 6 m long and will therefore temporarily cover an area of seabed approximately 12.6 m^2. Upon completion of the GEP installation operations, this suction anchor pile will be retrieved to the surface. Additional suction piles will be required for the mooring of the FPSO and are described in Section 4.6.3. An example of a suction anchor is shown in Figure 4.10.

During installation, both suction anchor piles are initially allowed to penetrate into the seabed under self-weight before water is pumped from the top of the pile to create a differential pressure, which results in additional penetration force driving the suction anchors into the seabed.

Table 4.12: Seabed footprints of temporary infield seabed obstructions

Obstruction Type	Identifier	UTM E [m]	UTM N [m]	(Diameter / L×W) [m]	Footprint on Seabed [m^2]
Temporary laydown areas (up to 20)	N/A	TBC	TBC	4 × 3 (× 20)	240
STP Buoy Suction anchor pile 1	STPBAP	TBC	TBC	6	28.3
GEP Suction anchor pile 1	GEPAP	TBC	TBC	4	12.6
Total					**280.9**

Figure 4.10: Illustrative example of a suction anchor.

Table 4.13 provides the locations and footprints of all other infrastructure associated with the export pipeline. Although the final foundations and installation methods for these are still being designed, it is currently anticipated that gravity-based structure will be used for the Cambo and Rosebank PLETs, as a worst-case estimate to the purposes of the EIA.

Table 4.13: Location and seabed footprints of GEP infrastructure

GEP Infrastructure	UTM E [m] / Start Point	UTM N [m] / End Point	Length [m]	Installation Width [m]	Total [m^2]
Cambo PLET	439,584	6,742,996	9	5	45
Gas Export Pipeline	Cambo PLET	Rosebank PLET	32,500	0.2032	6,604
Gas Export Pipeline suction anchor pile	TBC	TBC	6	4 (diameter)	12.6
Rosebank PLET	464,876	6,761,360	9	5	45
Gas export jumper	Rosebank PLET	ILT	106	0.323	34
Cable Crossing 4	457,063	6,756,274	6 (×6)	3	108
Cable Crossing 5	444,737	6,748,251	6 (×6)	3	108
Total					**6,956.6**

4.5.6 Subsea Installation Support Vessels

Various installation and support vessels will be associated with the subsea installation activities. Table 4.14 provides an overview of the estimated vessel requirements and durations with regard to the subsea installation and commissioning activities.

Table 4.14: Vessel requirements and estimated fuel consumption during SPS/SURF installation

Activity	Vessel	Consumption Rate [tonnes/day]	Duration* [days]	Total Fuel Consumption [tonnes]
Xmas tree installation	DP CSV	22	48	1,056
Structure installation	DP CSV / HLV	22	29	638
Flowline / umbilical / jumper installation	DP CSV	22	85	1,870
Riser installation	DP CSV	22	69	1,518
Heading control (FPSO)	Anchor Handling Vessel (AHV)	16	62	992
Survey / commissioning	Utility / Survey Vessel	14	130	1,820
Gas Export pipeline system installation	Reel Lay Vessel	17	27	459
Gas Export flexible jumper installation / system pre-commissioning	Utility / Survey Vessel	14	39	546
Total diesel consumption [tonnes]				**8,899**

Notes
* Includes 30% waiting on weather (WOW) time

4.5.7 Inspection and Maintenance

An integrity management system will be developed, and inspection programmes implemented for the subsea system. The inspection tasks for the subsea facilities shall be undertaken by an appropriate system capable of capturing the data required, this can include ROV or In-line Inspection systems. Inspection programmes shall be developed to cover all elements of the subsea system. The inspection programmes shall be based on three levels of inspection: general visual inspection, close visual inspection and detailed inspection. Inspections will be undertaken at a frequency determined by the integrity management system, with the necessary corrective maintenance performed if defects are identified.

In general, the subsea equipment is designed for the field life time such that no maintenance subsea is required. One exception would be for cleaning of marine growth/fouling from equipment and calcareous deposits around couplings/connections, if this was found to be required.

4.6 Floating Production, Storage and Offloading (FPSO)

4.6.1 FPSO Concept

The general arrangements onboard the FPSO comprise fluids reception, processing, metering, utility and offloading facilities, plus power, controls, communications and chemicals for delivery to the wells. The FPSO will have a total product storage volume of circa 103,342 m^3 (650,000 bbls).

The produced fluids enter the FPSO via two production flowlines. The FPSO inlet facility consists of permanent pig traps (launchers/receivers) for each flowline. Each flowline has its own riser and choke valve, after which the fluids are commingled together in the production manifold. The combined fluids are then sent to the separation unit.

The separation unit separates the raw gas, unstabilised oil and untreated produced water from each other as follows:

- Separated gas will be routed to the compression section:
  - Flashed gas from the 2nd Stage Separator is mixed with recovered gases, with the combined gas routed to the LP Compressor unit.
  - Gas from the LP Compressor unit is mixed with the gas from the 1st Stage Separator, with the combined gas routed to the HP Compressor Unit. The compressed HP gas is then sent to the gas treatment train (H_2S and Mercury removal, gas dehydration and TEG regeneration) to achieve the required gas specification.
  - A fraction of the treated gas is sent to the fuel gas treatment for fuel gas demands. The remaining treated gas is sent to the Export Gas Compressor for gas export (metered) and gas lift purposes.
- Separated oil will be stabilised to within the required specification and then stored in heated storage tanks (located in hull of the FPSO) prior to being metered and exported via tankers.
- Separated produced water will be treated within required specification for discharge to sea.
- Sand slurry shall be sent to the sand management system with the clean sand slurry discharged overboard.

The FPSO will also have following topsides utilities:

- Chemical Injection Systems;
- HP & LP Flare Systems;
- Vapour Recovery;
- Cooling Medium;
- Heating Medium;
- Fuel Gas;
- Compressed (Instrument) Air;
- Main Power Generation and Waste Heat Recovery (Dual-fuel turbine generators);

- Seawater Treatment and Injection (Note that seawater lift pumps are not part of the topsides);
- Fresh Service Water;
- Drains (Closed, Open, TEG Drains etc.); and
- Nitrogen generation

Furthermore, the FPSO will provide safety systems necessary for safe and efficient operations.

4.6.2 Design Parameters

The design parameters for the FPSO are based on the anticipated maximum production profiles presented in Appendix 5. The average annualised maximum anticipated production rates are 6,439 m^3/day of oil (high, mid, and low case), 664,844 Sm^3/day of gas (mid case) and 8,585 m^3/day of water (mid and low case). The production facilities capacities design parameters are summarised in Table 4.15.

Table 4.15: Design parameters for production facilities onboard the FPSO

Parameter	Value [Metric]	Value
Oil	7,154 m^3/day	45,000 bbls/day
Produced water	9,539 m^3/day	60,000 bbls/day
Total liquids	11,129 m^3/day	70,000 bbls/day
Water injection	10,334 m^3/day	65,000 bbls/day
Gas Production	1,132,663 m^3/day	40 MMscf/d
Gas Lift	849,497 m^3/day	30 MMscf/d
Gas compression [total]	1,982,161 m^3/day	70 MMscf/d
Gas Export	849,497 m^3/day	30 MMscf/d

4.6.3 Mooring and Installation

The FPSO is proposed to be located at 60° 48’ 32" N, 004° 07’ 25" W and will be moored to the seabed using up to 18 suction anchors similar to that described in Section 4.5.5 and Figure 4.10. The FPSO will be connected to the anchors via mooring lines in a 3-cluster configuration (3 bundles with up to 6 mooring lines each). Figure 4.11 illustrates the FPSO in the proposed field layout.

The suction anchors for the FPSO mooring lines will be 7.5 m in diameter and up to 32 m long. Therefore, each suction anchor will cover an area of seabed approximately 44.2 m^2.

The anchor line arrangement will comprise an upper chain or wire section, approximately 150 – 200 m long, connected to polyester ropes running down from the FPSO, with a short section of chain (150 m) connecting the polyester anchor ropes to the anchor piles on the seabed. Once the suction anchors are in place, the movement of the anchor lines on the seabed will be minimal. The anchor line arrangement will comprise short sections of chain (150 m) lying on the seabed, at each anchor pile. As a worst-case estimate, it is expected that a maximum 120 m length of anchor chain will raise and lower on the seabed during extreme weather events, with

30 m from the anchor piles remaining static on the seabed at all times. Lateral movement of the anchor lines will therefore be restricted to a maximum distance of 5 m on either side of each anchor chain at the furthest extent from the anchor piles.

Consequently, based on a maximum of 18 anchor lines being deployed in total, this would potentially result in an overall area of 10,800 m^2 of seabed being periodically disturbed throughout the life of the field. Once connected to the FPSO, the polyester ropes will be fully suspended in the water column and will not be in contact with the seabed.

Prior to the FPSO arriving at the Cambo field for installation, the STP, anchor chains and polyester mooring lines will be installed and laid on the seabed ('wet stored') for up to 1 year.

Table 4.16 provides an overview of the estimated vessel requirements and durations associated with to the installation of the mobilisation and hook up of the FPSO.

Table 4.16: Vessel requirements and estimated fuel consumption during FPSO installation

Activity	Vessel	Consumption Rate [Tonnes/Day]	Duration [Days]	Total Fuel Consumption [Tonnes]
Installation of FPSO mooring anchors / lower chains	DP CSV	22	39	858
Installation of FPSO mooring lines / upper chains	AHV	16	33	528
FPSO tow to field	AHV (×3)	16	35	560
FPSO Mooring line hook-up / tensioning	AHV (×2)	16	31	496
Total				**2,242**

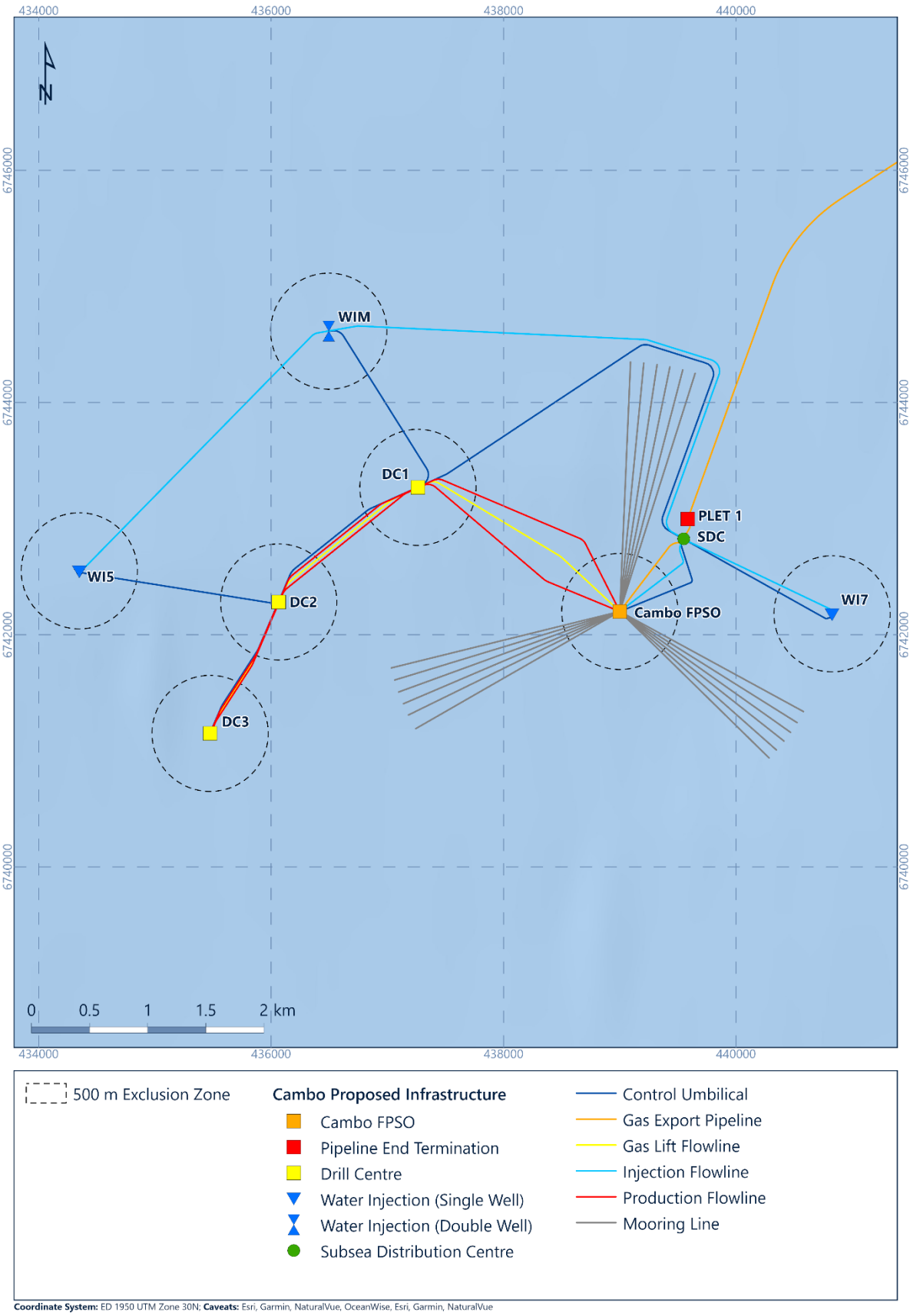


Figure 4.11: Proposed Cambo field development layout

4.6.4 Facilities Overview

Produced hydrocarbons will be processed onboard the FPSO, with the produced oil being exported via shuttle tanker and made available for sale on the open market. Produced gas will be used to meet the FPSO's power requirements. The combustion plant for power generation will have a nameplate capacity of up to 211,244 m^3/day (7.46 MMscf/day) produced gas. Any excess produced gas will be conditioned for export via the new pipeline which ties into the Cambo Gas Export Pipeline (GEP) which then ties into the Rosebank gas export system. This, in turn, ties into the West of Shetland Pipeline System (WOSPS) allowing excess produced gas to be sent to Sullom Voe, Shetland. At the Sullom Voe terminal the gas is then processed and used for power generation at the terminal, with the remainder being exported to mainland Scotland via the Shetland Islands Regional Gas Export (SIRGE) pipeline into the UK's National Transmission System for distribution and use across Great Britain.

Depending on when a renewable energy source will become available to provide electrical power the Cambo FPSO in the future, the GEP pipeline can also be used to import fuel gas, when the Cambo field itself becomes gas deficient, which is currently expected to occur sometime between 2036 and 2042.

Figure 4.12 provides a simplified overview of the process facilities for the proposed field development.

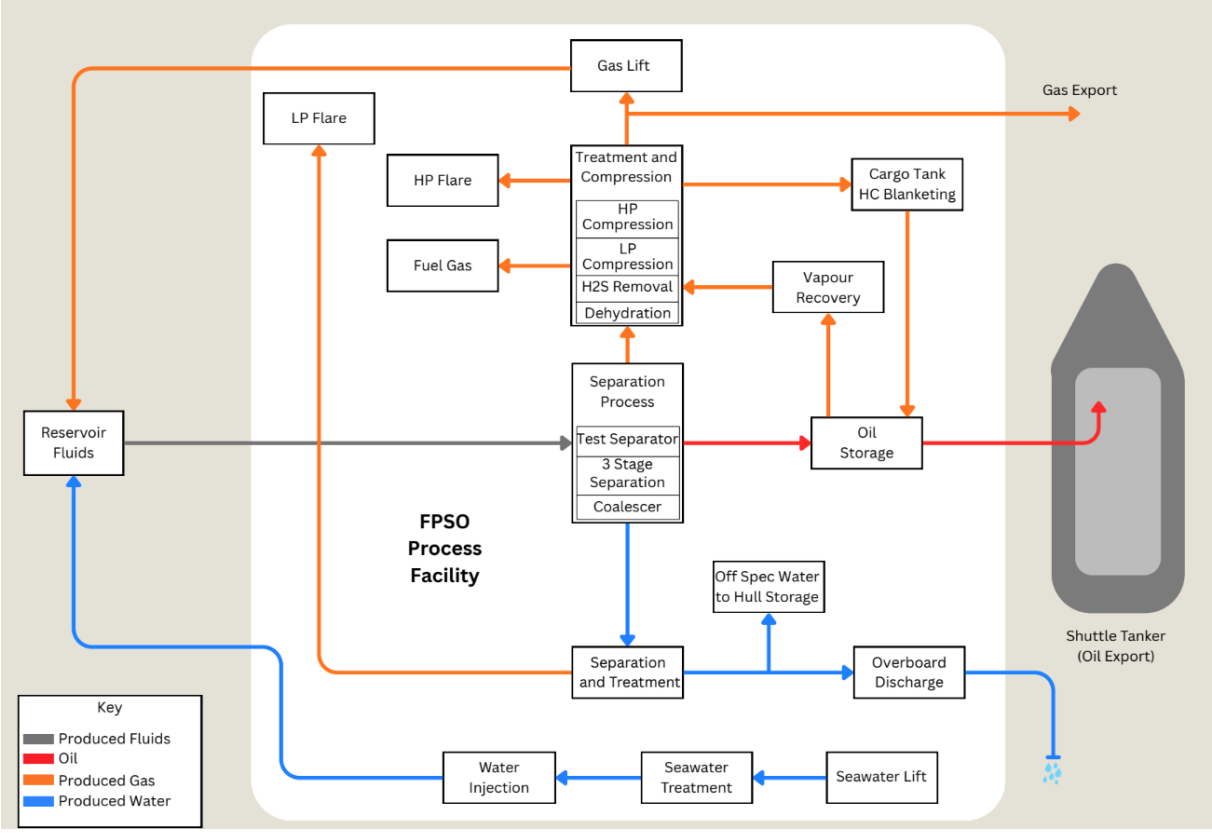


Figure 4.12: Cambo process facilities overview

4.6.5 Oil Processing

4.6.5.1 Oil Separation System

The well fluids from the production header are routed to the 1st Stage Separator which is a three-phase vessel and is designed to separate untreated gas, unstabilised oil and untreated produced water from one other. The 1st stage separation process train will also have a clean-up / test separator to support well start-up, testing and optimisation. The clean-up / test separator shall be installed in parallel to the 1st stage production separator to allow the fluids from one riser to be diverted to the production separator and the second to the clean-up / test separator.

The separated gas from the 1st Stage Separator is routed to the 1st Stage High Pressure (HP) Compressor Suction Scrubber.

Separated oil is sent from the 1st Stage Separator to the downstream system whilst produced water is routed to the produced water system treatment unit. Both oil and produced water outlet streams have analysers to measure the WiO and OiW respectively. Chemical injection for demulsifier and reverse demulsifier are also provided on the oil and produced water stream respectively.

Tie-in points on the 1st Stage Separator water and oil outlet lines are provided to allow any contaminated liquids to be routed to a temporary clean-up package during well clean-up operations.

The 1st Stage Separator is also provided with a nitrogen blanketing facility for maintaining minimum pressure necessary for liquid evacuation in case the arriving gas is not sufficient (for example, during hot oil flushing scenarios).

A produced water recycle stream in the 1st Stage Separator is included in case it is required to re-process water that does not meet discharge specification and also to prevent unstable emulsions with the water and oil.

4.6.5.2 Oil Stabilisation System

The oil that is separated in the 1st Stage Separator is heated by 3 × 50 % Crude Oil Heat Exchangers followed by 3 × 50 % Crude Oil Heaters and then routed to the 2nd Stage Separator. The 2nd Stage Separator is a three-phase vessel equipped with a vessel internal electrostatic coalescer (VIEC) to facilitate breakdown of emulsion.

The crude oil that is separated in the 2nd Stage Separator is routed to the Mechanical Coalescer via the Crude Oil Transfer Pumps. Produced water separated in the 2nd Stage Separator is pumped to the Produced Water Treatment System via the 2nd Stage Separator Produced Water Pumps. Both oil and produced water outlet streams have analysers to measure the WiO and OiW respectively. Chemical injection for demulsifier and reverse demulsifier are also provided on the oil and produced water stream respectively. A route to the off-spec tank is provided from the 2nd Stage Separator Oil Outlet.

The flashed gas from 2nd Stage Separator is routed to the 1st Stage LP Compressor Suction Cooler. Spill over pressure control is provided to allow excess gas routing to the LP flare in case the LP compression system is unable to handle all the gas coming into the separator.

The 2nd Stage Separator is provided with nitrogen blanketing facility for maintaining minimum pressure necessary for liquid evacuation in case the arriving gas is not sufficient (e.g. during hot oil flushing scenarios).

The pumped, stabilised oil from the Crude Oil Transfer Pump is routed to the Mechanical Coalescer where further water and oil separation occurs to achieve the required basic sediment and water specification in oil of 0.5 % vol. As a vessel internal electrostatic coalescer (VIEC) is included within the 2nd Stage Separator, an electrostatic coalescer is deemed unnecessary and therefore a mechanical coalescer has been selected.

The stabilised crude oil from the coalescer is routed to the cargo oil tanks in the hull via the Crude Oil Heat Exchangers. Produced water from the coalescer is pumped to the Produced Water Treatment System using the Coalescer Produced Water Pump with level control and with recycle flow control to achieve the targeted separation performance and for meeting pump minimum flow requirement.

The pumps in the separation system are low shear type to minimise the oil emulsification.

4.6.6 Gas Processing

4.6.6.1 Low Pressure (LP) Compression

The gases from the 2nd Stage Separator (Section 4.6.5) and Vapour Recovery Blower are commingled and sent to the LP Compressions System which comprises two identical trains which are designed to compress gas flow to the required pressure to reach the suction of the High Pressure (HP) Compression System (Section 4.6.6.2).

The LP gas compression system consists of a two-stage rotary dry screw compressor with common electric motor drive.

Condensate from the 1st and 2nd Stage LP Compressor Suction Scrubbers is routed to the 2nd Stage Separator.

4.6.6.2 High Pressure (HP) Compression

The gases from the 1st Stage Separator (Section 4.6.6) and the LP Compression System (Section 4.6.6.1) are mixed together and routed to the HP Compression System which comprises two identical trains (2 × 50 %) which is designed to compress the gas flow to high pressure for treatment.

Both the HP Compressors are of centrifugal type in back to back configuration and run on common shaft. Condensate from the 1st and 2nd Stage Suction Scrubbers is routed to the 2nd Stage Separator using respective level control. Discharged gas from the 2nd Stage HP

Compressor is sent to the gas treatment system for the removal of hydrogen sulfide (H_2S), mercury and water to allow the treated gas to be exported or used for gas lift as required.

4.6.6.3 Gas Sweetening System

The compressed gas from the HP compressors is routed to the Gas Sweetening Package which includes the Gas Sweetening Inlet Filter/Coalescer followed by H_2S Removal Beds. Design loading for the beds is 300 parts per million by volume (ppm_v) H_2S with an outlet spec corresponding to no more than 1.4 ppmv, and the sizing is based on bed changeout on annual basis. The bed material will also be selected to be suitable for mercury removal. For mercury, the design loading for beds is 0.54 µg/Sm^3 with outlet spec of 0.01 µg/Sm^3. The inlet filter/coalescer will remove any liquid/solid particles to the downstream beds. Similarly, the H_2S Removal Bed After Filter is provided to remove any particle carryover from the upstream beds.

Although H_2S levels are not anticipated to exceed a concentration of 300 ppm_v during normal operations, H_2S scavenger injection points will be installed on the outlets of the 1st and 2nd stage separators, as a contingency measure, to ensure the design loading for the H_2S removal beds is never exceeded.

4.6.6.4 Gas Dehydration System

After removal of H_2S and mercury, the gas is routed to the Glycol Dehydration system which works on the principle of contacting a liquid desiccant (Triethylene Glycol (TEG)) to remove any remaining water content from the gas stream.

In the TEG Contactor, the wet feed gas is contacted with lean TEG to remove water from the feed gas by physical absorption and to meet the gas specification water content of less than 35 ppm_v.

This is then sent to the TEG Regeneration Package by level control where it is electrically heated to a temperature high enough to remove the majority of absorbed water using stripping gas. The regenerated TEG (lean) is then cooled and re-circulated back to the TEG Contactor.

Any condensate collected at the bottom of the TEG Contactor is skimmed off and routed to the 2nd Stage Separator. Drains from the TEG Contactor and TEG Regeneration Package are routed to a dedicated TEG Drainage System.

A portion of dehydrated gas exiting the TEG Contactor is used as fuel gas and the remaining is sent to the Export Gas Compression for pressure boosting before routing to lift gas / gas export.

4.6.6.5 Export / Lift Gas Compression and Gas Import Systems

The Export Gas Compression System consists of two trains (2 x 50 %) designed to take the treated gas from the TEG Contactor and to compress it to the required pressures for export/gas lift.

Each Export Gas Compression Train comprises an:

- Export Gas Compressor Suction Scrubber;
- Export Gas Compressor; and
- Export Gas Compressor Discharge Cooler

Discharge gas from the Export Gas Compressor system is used as lift gas, while any excess is exported through the Export Gas Fiscal Metering Package.

During normal operations, when more gas is produced than consumed by the fuel gas system, the Cambo FPSO will be operating in "gas export mode". Later in field life, the system may operate in "gas import mode" when the field does not produce sufficient gas for gas lift and fuel gas demands (expected to be between 2036 and 2042).

Gas import will also be required during the start-up of the FPSO to meet fuel gas requirements (including purging and operational needs) along with lift gas for 2 wells. Cold import gas from the export pipeline is first sent to the Import Gas Fiscal Metering Package, which along with fiscal metering contains the analyser shelter for Moisture / Dew Point / H_2S / Mercury analysis and gas chromatograph. The gas is let-down in pressure and then sent to the Import Gas Scrubber to remove any liquids that might be formed before being routed to the Import Gas Heater. The heated imported gas is then sent to the inlet of the gas treatment trains for H_2S removal prior for usage.

4.6.7 Produced Water Treatment

Produced water will be treated and discharged to sea under normal operations, as re-injecting produced water has the potential to sour the gas in the reservoir and will present injectivity issues (see Section 3.2.3.3). The produced water treatment system has a capacity of 9,539 m^3/day (60,000 bbls/day).

Untreated produced water is routed to the Produced Water Treatment Package (PWTP) to be treated, so it can be discharged overboard. The PWTP is designed to reduce the oil content in the produced water to a target of ≤ 15 ppm oil in water (monthly average), prior to overboard disposal.

Untreated produced water from the 1st Stage Separator (Section 4.6.5) is routed directly to the PWTP. It is anticipated that, as this separator is the first one in the separation unit, most of the untreated produced water will come from this vessel. Produced water from the 2nd Stage Separator and the Mechanical Coalescer (Section 4.6.5) will also be routed to the PWTP.

During normal operations, the temperature of the produced water from these vessels will be approximately 93 °C but will be mixed with the colder produced water from the 1st Stage Separator in the PWTP such that the temperature of the treated produced water to be discharged to sea will be between 27 and 33°C.

The PWTP is anticipated to include desanding hydrocyclones, deoiling hydrocyclones, produced water gas flotation vessel and gas flotation unit (GFU) eductor.

Treated produced water from the PWTP will be discharged overboard by the Produced Water Discharge Pump. The Produced Water Discharge Pump includes an OiW sampling analysis point and the produced water flow can be diverted to the off spec / slops tanks in the hull for further treatment if the OiW content does not meet the required discharge specification of ≤ 15 ppm.

Should sufficient volume be unavailable for storage of produced water, the procedure will be to restrict or shut in production until the produced water is brought back into specification.

4.6.8 Flaring and Venting

All processing facilities on the FPSO will be designed to operate without the need for routine flaring or venting of hydrocarbons for operational purposes. However, flaring and venting systems will be installed to safely manage non-routine operations, such as process start-ups / shut downs / upsets and emergency situations.

A High Integrity Pressure Protection System (HIPPS) Closed flare system will be installed on the FPSO. The system will be segregated into HP and LP flare subsystems both operating as closed loops under normal conditions to facilitate gas recovery. The HP Flare and LP Flare system are completely separated from each other, and each comprises collection headers, knock-out (KO) drum, KO drum pumps, flare gas metering and flare stacks. A Vapour Recovery Unit (VRU) will be installed to capture and recycle fuel gas.

The flare system will be designed to safely handle gas releases under the following circumstances:

- Start-up conditions when the compression train, H_2S removal and gas dehydration must be brought online and stabilised;
- Relief device discharges to protect equipment and/or systems from over pressure caused by process upsets;
- Emergency flaring caused by depressurisation of systems due to fire or gas detection.

During any of these non-routine operations the flare gas will flow through the flare knock-out drums to remove any liquid before it is combusted. It is anticipated that (as a worst-case estimate) up to 0.86 million cubic metres of gas per year will be flared off during process upsets and other emergency situations. The flare systems will be metered so any flared gas can be monitored.

As the flare systems are closed to the atmosphere, flare purging (a process to prevent oxygen filtration into the flare tip) will be undertaken during active flaring events. Fuel gas will be the primary source for purging with nitrogen utilised as a back-up gas source.

There also will be no routine venting of unburnt hydrocarbons. Venting from cargo tanks will normally be recovered by the VRU and routed to LP compression.

4.6.9 Sand Production and Disposal

The Cambo reservoir formations comprise weak sands and sand control is essential to prevent significant sand production to the surface. Currently it is planned to complete the production wells using alternate path open hole gravel pack (AP OHGP), as successfully used for the test of well 204/10a-5Y. Alternatives including alpha/beta gravel packs, Baker Hughes General Electric's (BHGE's) GeoFORM ™ or the use of standalone screens (SAS), are being assessed as alternatives to AP OHGP.

Water injection wells will be completed with stand-alone screens (SAS) to prevent sand production during possible temporary flow back or cross-flow when wells are shut-in.

In addition, periodic removal and clean-up of sand will be undertaken to remove sand and other solids that have settled at the bottom of vessels in the separation train including the 1stStage Separator, Closed Drain Vessel and the Produced Water Treatment Unit (specifically the desanding hydrocyclones and gas flotation vessel).

Treated produced water from the sand jetting pumps will be used to remove the sand from these vessels forming sand slurry which is removed via the respective slurry eductors and transported to the sand clean-up package.

Clean sand slurry from the sand clean-up package will be discharged overboard provided the oil in sand specification is met (≤ 1 % by weight of oil). If required, sand slurry can be returned to the sand clean-up vessel within the Sand clean-up package for further washing to reduce the oil in sand specification. Oily water separated from the sand clean-up package is routed to the 2nd Stage Separator.

The washing and overboard disposal of sand is expected to be a batch process, which operates intermittently.

4.6.10 Oil Storage and Offloading

The cargo handling system is designed to permit loading of cargo oil from the topsides into cargo tanks while also simultaneously offloading from other cargo tanks or performing crude oil washing or transferring from one tank to another. Cargo storage volume is approximately 103,342 m^3 (650,000 bbls).

Each cargo tank will have submersible cargo pumps installed for the discharge of oil from the tanks. Oil export pipework will route cargo from the tanks to an export hose reel. Connection of the FPSO to the shuttle tanker will be via flexible offloading hose.

Oil will be exported from the FPSO via tandem offloading to a dynamically positioned export shuttle tanker. The offloading system will be designed to offload a full cargo parcel within a 24-hour period.

At peak production rate, the offloading frequency of the FPSO for an expected offload tanker volume of 79,494 m^3 (500,000 bbls) will be one every 12-13 days (depending on the operational buffer of tank volume prior to the start of offloading). As production declines in later field life, the offload frequency will decrease gradually over time.

4.6.11 Utility Systems

4.6.11.1 Seawater Treatment

The seawater treatment system receives seawater at the hull/topsides interface from either the Process Seawater Lift Pumps (during normal operations) or the Emergency Seawater Lift Pumps / Emergency Coarse Filter package (during black start operation).

During normal operations, seawater is routed through the Sea Water Coarse Filtration Package located at the FPSO topsides. The filtered seawater is distributed to Process Cooling Medium Coolers, Heating Medium Trim Cooler, Main Power Generators Package cooling, topsides utility stations and the Water Deaerator Vacuum Package. The water can also be pumped back to the hull.

During the black start of the initial Gas Turbine Generator (GTG) set, seawater will be supplied via the Emergency Seawater Lift Pumps and Emergency Coarse Filter and routed through the Topsides Seawater Coarse Filtration Package. Once the first GTG and the Process Seawater Lift Pump are operational, the switchover and subsequent return to normal operations will be manually controlled through the topsides piping and valve arrangements. The Process Seawater Lift Pumps, Emergency Seawater lift Pumps, Emergency Coarse Filter and Electro-chlorination Package are all located in the hull facilities.

During normal operations, seawater is pumped by the Process Seawater Lift Pumps from Hull to the topsides. The seawater is filtered in the Sea Water Coarse Filtration Package and then distributed to various topside users. These filters are of self-cleaning type and provided with automatic backwash facility.

The majority of the filtered topside seawater is directed to the Process Cooling Medium Coolers, where it will be used to lower the temperature of the incoming cooling medium stream. In normal operations, excess seawater downstream of the coolers is dumped overboard.

The seawater outlet temperature is maintained at a maximum of 34 °C to optimise system performance and prevent scale precipitation to downstream equipment. If the feed pressure into the Seawater Ultra Filtration Package rises above the pressure indicator controller (PIC) set point, the controller will start spilling seawater overboard. Similarly, if the feed seawater

temperature rises above the temperature indicator controller (TIC) set point, this controller will override PIC and start spilling seawater overboard.

This warm seawater is routed to Seawater Ultrafiltration Package followed by sulphate removal unit (SRU) Package via SRU Feed Pump Skid to remove sulphates in the seawater from 2,770 mg/l to a maximum 100 mg/l. If required, the SRU system can also be operated at lower temperature than normal 34 °C, albeit at reduced capacity.

The remaining seawater is routed to the Main Power Generation Packages and the seawater utility stations.

After sulphate removal, seawater is sent to the Water Deaerator Tower where oxygen is removed (to 10 ppb specification) by a combination of vacuum deaeration using Water Deaerator Vacuum Package and injection of oxygen scavenger to minimise the corrosion of the subsea equipment. Water level in the tower is maintained by level controller adjusting the inlet flow as well as through the dump valve on the discharge of downstream of the Water Injection Booster Pump.

4.6.11.2 Water Injection

The deaerated seawater from the Deaeration Tower is pumped through the Water Injection Booster Pump to meet the needs of the Main Water Injection Pumps. The Main Water Injection Pumps are part of the Seawater Injection Pump Package and include motor drives and pump auxiliaries. Cooling medium is provided for cooling lube oil cooler / seal barrier fluid coolers. Instrument air is provided for pneumatic operated charging pumps. The Main Seawater Injection pumps are provided to transfer injection water from the suction manifold to the water injection flowline via water injection riser.

4.6.11.3 Drainage System

The drainage systems allow for the safe removal of residual process and wash-down fluids from the vessels, pipes, and instruments, resulting either from operational activities or from preparation prior to carrying out maintenance work. In addition, there are several relief sources from various packages that are routed into the drains system. The fluids are collected and returned to the main process or disposed of in a safe and environmentally acceptable manner.

Closed Drain System

The Closed Drains system is designed to collect liquid hydrocarbons from various process equipment, process packages and piping from hazardous systems containing toxic or hydrocarbon liquids at high-pressure sources during maintenance or planned shutdowns, into a common Closed Drain Vessel.

The accumulated liquids are pumped via Closed Drain Pumps to the 2nd Stage Separator for re-processing. In the event that introduction of closed drains liquids are found to cause process upsets, the liquids will be pumped to the slop tanks in the Hull. Any evolved gases will be

vented to the LP Flare system and the Closed Drains Vessel pressure will normally vary as a function of the LP Flare header pressure.

Open Drain System

The Open Drain system is designed to prevent the overboard discharge of oil contaminated rainwater as well as to collect intermittent manual drains from topside process and utilities areas. The open drains are classified into hazardous and non- hazardous open drains. Any areas with no equipment or with no possibility of contamination will be routed to non-hazardous clean drains for direct overboard.

The Hazardous Open Drain System collects small process deck drips and minor spills from designated hazardous areas (such as process decks) via drip trays, tundishes and drain boxes. The Non-Hazardous Open Drain system serves similar functions but is dedicated to the Non-Hazardous area (mainly utilities decks).

The Hazardous and Non-Hazardous Open Drain collection headers are then routed to respective collection tanks which are located in the Hull.

TEG Drain and Make Up System

The TEG Drain system is an independent drainage system collecting only TEG associated drainage fluids. The TEG drainage system collects TEG drainage fluids from the following sources:

- TEG Contactor;
- TEG Regeneration Package;
- Process and Utility Cooling Medium Systems;
- Heating Medium System; and
- Hull Utility Cooling Medium Expansion Tank.

Fluids from these sources are collected and routed to the TEG Drainage Tank and disposed of via the TEG Drainage Pump to tote tanks for onshore disposal.

4.6.11.4 Chemical and Methanol Injection

The Chemical Injection System facilitates the safe storage and delivery of chemical additives in their required quantities to various locations on the FPSO topsides, hull and subsea. The system comprises storage tanks, chemical injection pumps with associated piping, valving, and instrumentation.

All injection pumps are electric motor driven positive displacement pumps. Most of the storage tanks are gravity fed by dedicated tote tanks, located directly above the Chemical Injection Package, via hose connections. However, topside break tanks for H_2S scavenger, wax inhibitor / pour point depressant (PPD) and methanol will be filled under pressure, pumped from the hull tanks which, in turn, will receive chemicals via bunkering.

In the chemical injection skids, demulsifier, corrosion and scale inhibitors, H_2S scavenger, Methanol and Wax Inhibitor / PPD Storage Tanks in the topsides are nitrogen blanketed. Hull Chemical Storage Tanks are also nitrogen blanketed for tank interchangeability.

The drip pan drains from the chemicals will be led to a common Chemical Injection Drainage Tank which is sized for 110 % of the single largest storage / buffer tank volume in the Chemical Injection Systems. The collected chemical(s) will be disposed of via the Chemical Injection Drainage Pump to tote tanks for appropriate onshore disposal.

4.6.11.5 Compressed Air

The compressed air system supplies dry, filtered instrument air and plant (utility) air in two dedicated piping systems to the users throughout the FPSO facilities. One piping system supplies air to all instrument air users; and the other piping system supplies air for the plant (utility) air users including the Nitrogen Generation. The air quality in both the instrument air system and in the plant air system is identical.

The air compressor packages, air dryer packages, and hull air receiver are housed in the hull section of the FPSO. In contrast, the Topside Air Receivers are situated in the topside area.

4.6.11.6 Nitrogen Generation

The Nitrogen System within FPSO Topside Facilities is designed to produce nitrogen with a purity of 97 % using compressed air supplied from Air Dryer Package to meet users like compressor seals, blanketing and purging needs.

The Nitrogen Generation Package operating at 10.0 barg is a membrane-type system that separates air into nitrogen and oxygen-enriched air, which is vented to atmosphere at a safe location.

4.6.11.7 Power Generation

The FPSO will be provided with power generation capacity as shown in Table 4.17. The main power generation package comprises 3 × 50 % gas turbine generators (GTGs) with Waste Heat Recovery Units (WHRUs) which will utilise produced gas from the Cambo field until it becomes gas deficient. If Cambo becomes gas deficient before a reliable economic electrical power source is available as a power source, the GEP can be utilised to import fuel gas for power. The FPSO will be designed to be electrification ready which offers the potential for electric power to be imported via subsea cable.

Table 4.17: Cambo FPSO power generation

Power Generation	Main	Emergency	Auxiliary / Restart
Type	Gas turbine dual fuel (gas fuel DLE/liquid fuel LDI)	Diesel	Diesel
Site Rated power	21.0 MW each	2.5 MW	2.5 MW
No. of units	3 × 50 %	1	1

Each main generator will be coupled with a 11.5 kV electric generator with nameplate rating of no less than that of the turbine. Under normal operations, electric power will be supplied from electric generators powered by dual fuel, i.e. dry low NO_x emissions (DLE)/liquid fuel 'lean direct injection' (LDI) turbines.

Waste heat from the turbines will be used to provide process heating requirements through the installation of three WHRUs.

Post electrification, one GTG and all three WHRUs will be isolated and the total Cambo FPSO heating demand will be provided via an externally fed electric heater package. Therefore, the FPSO design also considers the provision to importing the required electricity via shore to satisfy the total Cambo electrical power demand post electrification.

One emergency diesel generator is used to provide emergency power for emergency safety systems, maintaining life support facilities and black-start facilities.

4.6.12 Fuel Use during Production

When the Cambo development starts up in 2030, the FPSO will initially be powered by diesel while various parts of the development are commissioned until enough produced gas becomes available to fulfil its own power requirements. It is estimated that the Cambo FPSO will consume up to 560 tonnes of diesel during the commissioning period in 2030. From 2031 onwards Cambo's own produced gas will be used to meet the FPSO's power requirements. Based on the current project design, Ithaca Energy expects that the use of fuel gas is expected to 192,204 m^3/day or 60.2 million cubic metres per year. The fuel usage values presented here, and throughout the remainder of the ES are Ithaca Energy's best estimates based on current project design parameters.

In addition, up to 76.5 tonnes of diesel per year will also be required for the weekly testing of the emergency diesel generator and the fire pumps and during potential process upset scenarios (estimated to be up to 6 events per year, when there is temporarily no fuel gas available, with each event lasting 8 hours).

4.7 Decommissioning

The infrastructure associated with the proposed Cambo field development will be decommissioned when operations are no longer economically viable and opportunities for potential hub operations have been exhausted.

All decommissioning operations will be undertaken in accordance with UK Government legislation and international agreements in force at the end of field life. In the UK, decommissioning is controlled through the Petroleum Act 1998, as amended by the Energy Act 1998. The UK's international obligations on decommissioning are governed principally by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention).

Wells will be decommissioned in accordance with the prevailing Oil & Gas Authority (OGA) guidelines. The selection of an FPSO allows it to be towed away and the current plan is to fully recover all infield flowlines and any other surface laid infrastructure or deposits at the time of decommissioning. All subsea structures above the mudline will be designed such that they can be retrieved upon abandonment in the event that 'abandon in place' is not permitted. Piles and mud mats will not be retrievable, but they can be cut at or below the mudline if required by regulations for abandonment of the field.

The decommissioning of the gas export pipeline will be subject to a comparative assessment, which will assess all potential decommissioning options available at the time, including complete recovery of the pipeline, as well as leaving (parts of) the pipeline in-situ. All decommissioning activities will be undertaken in compliance with regulatory requirements in force at the time of decommissioning and in consultation with regulators and other stakeholders.

The main considerations of the decommissioning process will be navigational safety, the prevention of marine pollution and prevention of damage to the marine environment. The ultimate intention is to leave the seabed development area in the condition that it will pose no harm to the marine environment.

Prior to the decommissioning process, re-use and recycling alternatives will be considered where feasible. In advance of the decommissioning process, an inventory of all project equipment will be made and an examination for further reuse will be carried out. Pre-decommissioning surveys will be carried out to establish the environmental baseline before decommissioning. The precise decommissioning methodology will depend upon operating conditions. Discussion on what may be required in an individual case will be held with the relevant authorities before commencing.

5. Local Environment

Information about the local environment at the proposed Cambo field development and its surrounding area has been collated to establish a baseline of conditions for features that might be affected by the proposed activities or influence the behaviour of potential contaminants.

The proposed field development is situated in United Kingdom Continental Shelf (UKCS) Blocks 204/4a, 204/5a, 204/5b, 204/9a, 204/10a, 205/1b and 205/2b, approximately 133 km to the west of the Shetland Islands from the Cambo Floating Production, Storage and Offloading vessel (FPSO) and adjacent to the UK/Faroe Island transboundary line. Figure 5.1 presents the proposed location for the Cambo field.

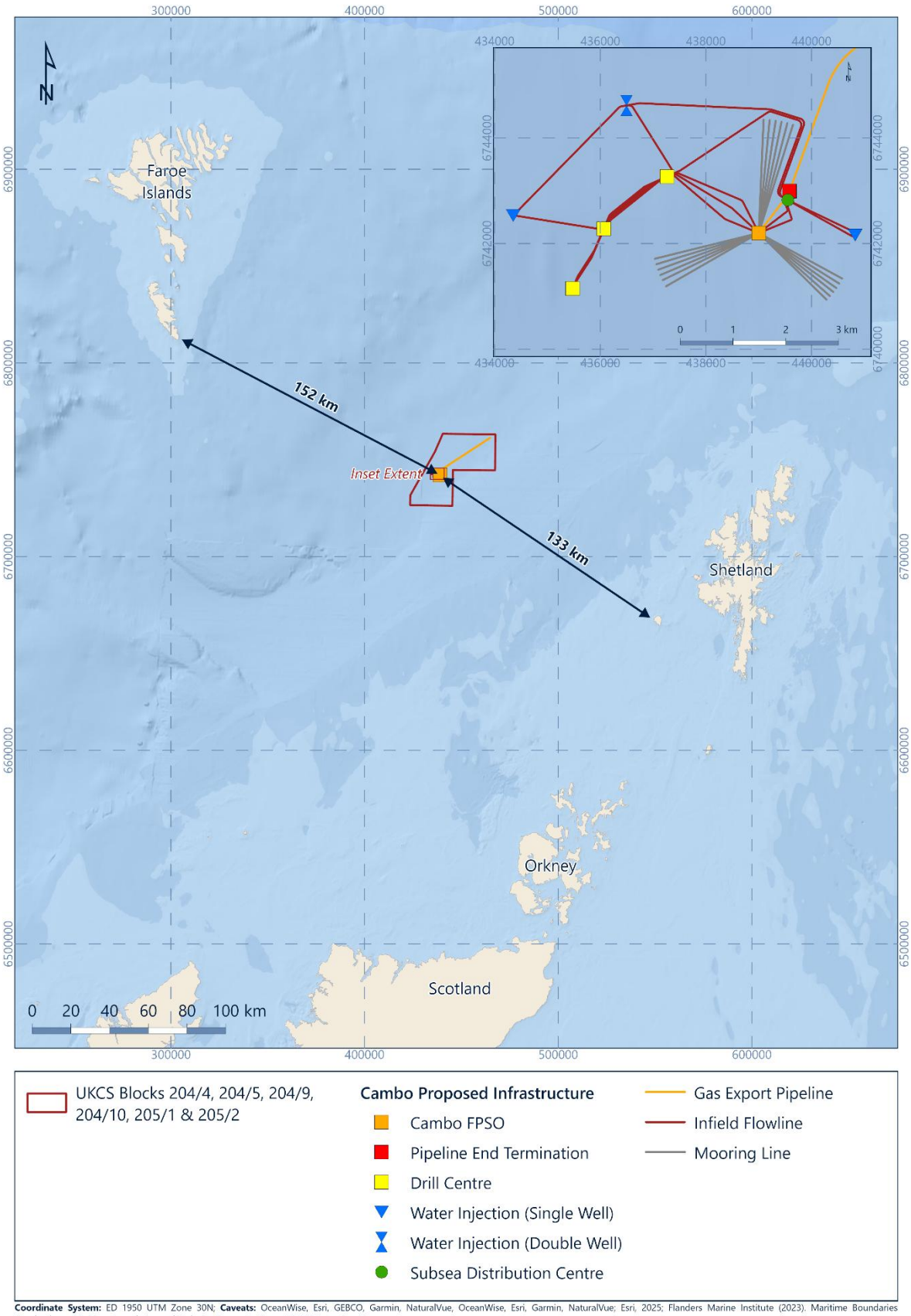


Figure 5.1: Location of the proposed Cambo field development

5.1 Data Sources

Information to inform baseline environmental conditions has been gathered from publicly available national and regional datasets, scientific surveys and scientific literature. Site specific information is drawn from specialist site specific surveys that have been carried out in the area around the proposed field development, as outlined below.

5.1.1 Environmental Surveys Relevant to the Proposed Cambo Field Development

Table 5.1 presents a summary of the ecological seabed sampling surveys that have been undertaken within the area of the proposals, and wider area. Figure 5.2 shows locations that have been sampled for seabed habitat and species information.

Table 5.1: Summary of previously obtained survey data in the area of proposals and wider region

Survey Commissioned By	Year	Name	Quadrant/Block/ Licence Area	Survey Details
Site Specific Surveys				
Ithaca Energy (Fugro, 2025a; 2025d)	2025	Cambo	Block 204/5a	Survey including environmental data acquisition within the proposed Cambo pipeline corridor Box core samples were successfully acquired at all 13 proposed stations. Autonomous underwater vehicle (AUV) camera data were successfully acquired at all 13 client predefined stations and 11 proposed features.
Siccar Point Energy (MMT, 2018)	2018	Cambo	204/4, 204/5,204/9, 204/10 and 204/5 to 205/21	Environmental baseline survey and habitat assessment using a remotely operated vehicle (ROV) to capture digital stills along eight transects, with one cross transect to target the Faroe-Shetland Sponge Nature Conservation Belt Marine Protected Area (NCMPA). Thirteen grab sampling locations were used for sediment sampling. Geophysical data acquired was used to identify areas of interest along the pipeline route.
Siccar Point Energy (Fugro, 2017)	2017	Cambo	204/10	Habitat assessment in the vicinity of well 204/10a-5 using an ROV to capture digital stills and video footage along eight 100 m transects centred on the proposed drilling location.
Chevron (Fugro, 2013)	2013	Cambo	204/6	Pre- and post-drill habitat assessment at Cambo 5 via ROV survey. Digital still photography and video footage was used for the assessment.
Hess (Fugro, 2011a)	2011	Cambo	204/5	Environmental survey of well 205/5a-1. Data gathered included bathymetric, side scan sonar (SSS), seabed photography and geotechnical core samples.
Hess (Fugro, 2011b)	2011	Cambo	204/10	Pre- and post-drill habitat assessment for well 204/10a-4. An ROV survey collected digital stills along four transects located southwest, southeast, northwest and northeast from the well centre. The assessment aimed to identify any reefs or annex 1 habitats.
Hess (Gardline, 2001)	2001	Cambo	204/10	Rig site and environmental survey for the original Cambo well location (well 204/10-1). Utilised analogue survey techniques and ground-truthed via digital stills and grab sampling.
Studies from the Wider Region				
Ithaca Energy (Fugro, 2024; 2025e; 2025f)	2025	Tornado	204 and 205	Environmental baseline survey and habitat assessment using grab and video acquisition at 15 locations was undertaken at the Tornado proposed, existing and relief well. 21 grab stations were sampled and 24 video locations along the proposed export route B pipeline.
Equinor (DNV, 2022)	2022	Rosebank	213/26b, 213/27a, 205/1a, 205/2a	Environmental baseline survey undertaken along two potential gas export routes from Rosebank to Clair and Rosebank to Cambo. 29 environmental stations were sampled for sediment physico-chemical and biological analysis.

Survey Commissioned By	Year	Name	Quadrant/Block/ Licence Area	Survey Details
Hess (Serpent, 2009)	2009	Rosebank (incl. Cambo)	204/10	ROV survey of the Cambo 3 well location. Eight video transects were used to analyse the seabed and habitats around the well location. Sediment cores were also taken for chemical and biological analysis.
DTI (2000)	1999	-	204	Broadscale regional survey that characterised the seabed habitats and communities in the region. Utilised analogue survey techniques and ground-truthed via digital stills, video systems and grab sampling.
AFEN (2000)	1996/1998	-	-	Broadscale regional survey that characterised the seabed habitats and communities in the region. Utilised analogue survey techniques and ground-truthed via digital stills, video systems and grab sampling.
Notes AFEN = Atlantic Frontier Environmental Network DTI = Department of Trade and Industry.				

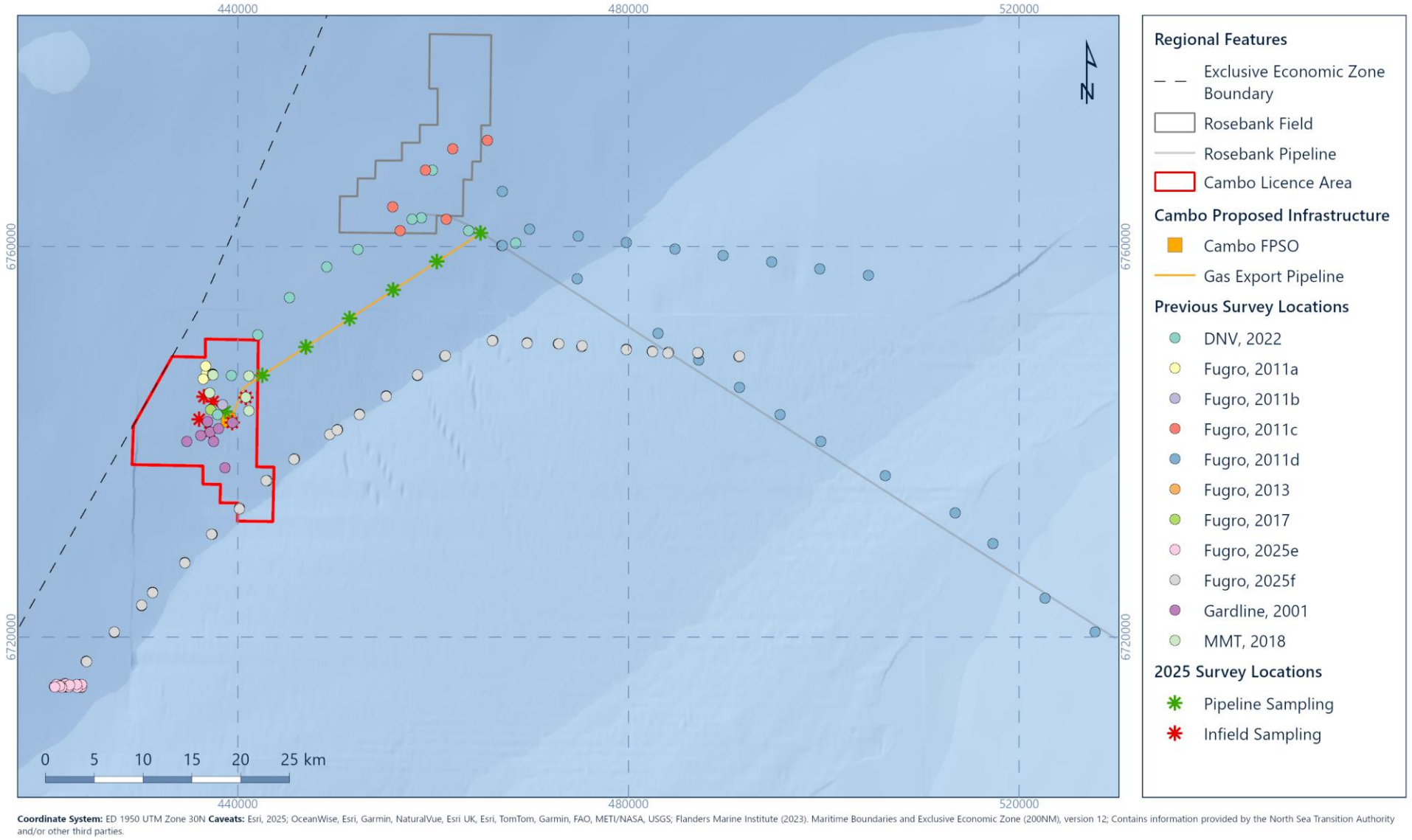


Figure 5.2: Previously obtained data in relation to the area of proposals

5.2 Site Specific Surveys

An environmental (Habitat Assessment (HA) and Environmental Baseline Survey (EBS)) survey within the proposed Cambo area was undertaken in 2025 (Fugro, 2025a; 2025d), following up from a desktop study undertaken by Fugro (2025i). The survey was carried out to inform planning for the installation of a surface laid pipeline between the proposed Cambo FPSO location and a tie-in point on the future Rosebank gas export pipeline (subject to commercial negotiations) to the West of Shetland pipeline system (WOSPS). Camera data were successfully acquired at 13 predefined stations and 11 proposed features using an AUV. Box core samples were successfully acquired at all 13 stations.

An environmental baseline survey and habitat assessment at the proposed Cambo field development footprint and the (former) proposed Cambo Gas Export Pipeline (GEP) route in 2018 was undertaken (MMT, 2018). An ROV was used to acquire seabed data together with seabed sampling using a dual Van Veen grab for grab sampling. A total of eight still image ROV transects and 13 grab sample sites were selected for sampling in field. An additional 32 km long imagery transect, with one short cross transect, was surveyed along a section of the pipeline route located within the Faroe-Shetland Sponge Belt NCMPA.

In 2001, a rig site and environmental survey was conducted around the original Cambo well location, Well 204/10-1 (Gardline, 2001). This survey investigated the seabed using analogue survey techniques such as echo sounders and SSS equipment as well as grab sampling and seabed photography at nine stations.

5.3 Physical Environment

5.3.1 Hydrography

The proposed Cambo field is located in the Faroe-Shetland Channel, a deepwater channel in the northeast Atlantic which runs between the Faroe and the Shetland Islands (Figure 5.3). The ocean current regime in the Faroe-Shetland Channel is complex due to the bathymetry of the area, the interaction of several different water masses, and seasonal variability in water flows. On a broad scale, cold dense bottom water from the Arctic Basin flows southwest along the channel floor, whilst warmer, Atlantic water flows over the top of it to the northeast. In total, five distinct water masses are present in the channel, each of which may be described in relation to their geographical position and vertical distribution in the water column (Berx, 2012; Figure 5.3).

The five water masses comprise (i) North Atlantic waters occurring at approximately 0-200 m water depth, originating from the south and enter the Faroe-Shetland Channel over the Wyville Thomson Ridge. These surface waters flow to the northeast through the channel, confined to the eastern (Scottish) slope (Debes, 2000; DECC, 2016; Hansen et al., 2017), (ii) modified North Atlantic waters are also present near the sea surface and up to 400 m depth, flowing to the north around the Faroe Islands, splitting into two currents, one flowing to the west and one to the northeast along the Scottish side of the Channel, (iii) the Modified East Icelandic Waters

which occur between 400 m and 600 m of depth. They enter the Faroe-Shetland Channel from the north and split to form two flows, with one moving northeast and one southwest along the channel (Turrell et al., 1999), (iv) the Norwegian Sea Intermediate Waters which occur at depths of around 600 m to 800 m. This water layer becomes shallower towards the Scottish slope and is often absent from this side of the channel (DECC, 2016). The net flow of the Norwegian Sea Intermediate Water in the channel is also to the southwest (Turrell et al., 1999), (v) the North Atlantic Deep Waters which occur below 800 m on the Faroe shelf side, flowing to the southwest along the channel floor.

Eddies frequently develop in the surface waters of the channel. These may be warmer, or colder, than the surrounding water, and tend to last for several days (Metoc, 2002). Internal waves can form at the interface between layers and may result in seabed surges and incursions of cold water to shallower regions (Metoc, 2002).

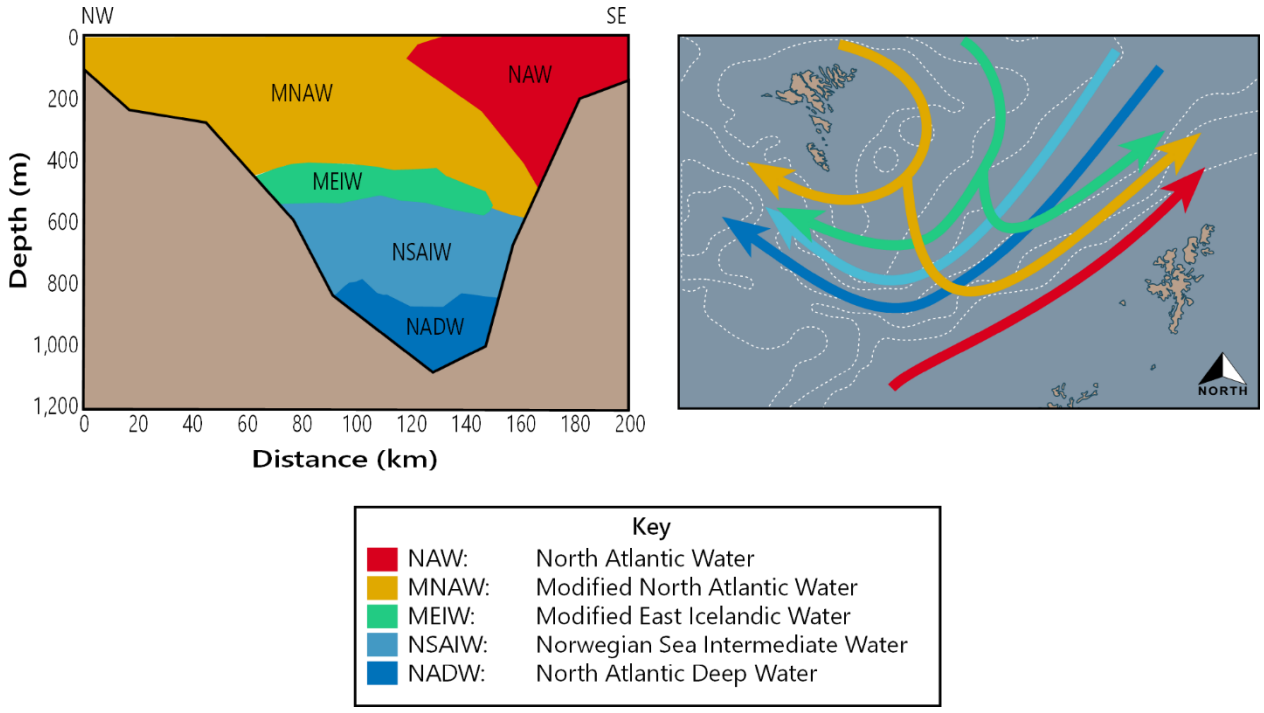


Figure 5.3: Water masses in the Faroe-Shetland Channel (Adapted from Berx, 2012)

Net flow of surface waters in the Faroe-Shetland Channel is to the northeast. Currents are strongest along the upper continental slope, where they average around 0.3 m/s. The mean velocity of the shelf edge current is approximately 0.4 m/s towards the northeast, and in the lower water mass 0.15 m/s towards the southwest (Saunders, 1990). Measured near-bottom current velocities indicate peak currents over 0.75 m/s on the upper continental slope to the West of Shetland (DECC, 2016).

Analysis of mean significant wave height and direction for the area around the proposed Cambo field development indicates that waves most frequently originate from the west and southwest (Figure 5.4). These wave directions are consistent with findings outlined in a Marine Directorate Assessment report (2020), which reported dominant wave direction from the west-

south-west and typical winter offshore wave heights of 5 m. Mean significant wave heights were recorded to be primarily around 4 m to 5 m.

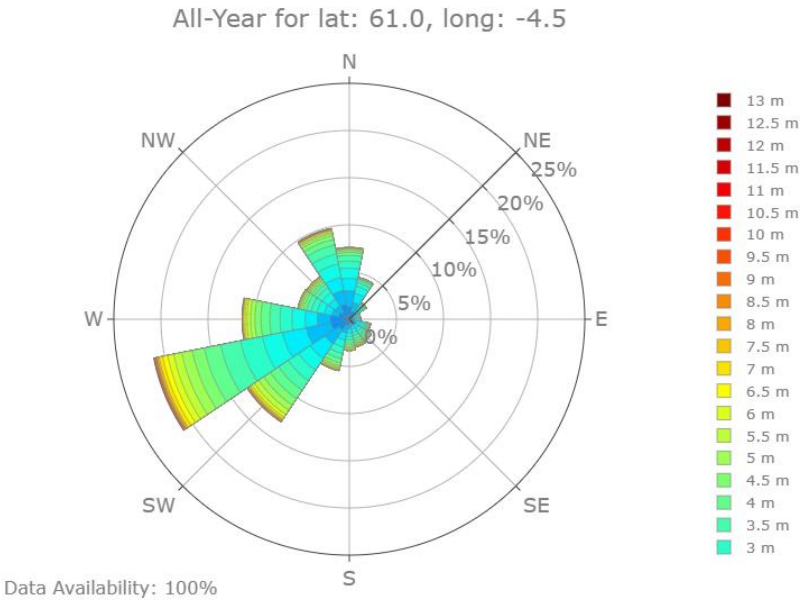


Figure 5.4: Annual mean significant wave height and wave direction in the area of proposals (Fugro Metocean Planner, 2025b)

A permanent thermocline is present in the Faroe-Shetland channel. The thermocline occurs at the boundary between the cold Arctic bottom waters, and the warmer North Atlantic waters which flow over them at a depth of around 400 m to 600 m (Debes, 2000; Serpent, 2009). Temperatures in the cold, dense bottom currents are typically below 0 °C and can be as low as -1.5 °C (Larsen et al., 2016). The temperature then quickly rises at the level of the thermocline, so that intermediate waters fluctuate within the range 3.0 °C to 4.5 °C (Heath & Jónasdóttir, 1999). Sea surface temperatures in the Faroe-Shetland Channel vary seasonally from a minimum of 5.5 °C to a maximum of 11.4 °C (Larsen et al., 2016). A shallower thermocline may also develop in the surface waters during the spring and summer to depths of between 20 m and 50 m, depending on wind conditions (Debes, 2000).

Both surface waters, the North Atlantic Water and Modified North Atlantic Water, are the most saline water layers in the Faroe-Shetland Channel, transferring salt from the Atlantic through the channel to the Nordic seas (Berx, 2012). Salinity decreases with increasing water depth and density.

Mean surface salinities in the area were found to be around 35 ‰ (NMPi, 2025). Recent studies have found that temperature and salinity of the surface waters of the Faroe–Shetland Channel have generally increased over the past two decades (Larsen et al., 2016).

5.3.2 Meteorology

The proposed field development region has a generally mild, maritime climate resulting from prevailing south-westerly winds and the warming influence of the Atlantic Continental Slope current (DTI, 2003). The area around the proposed field development experiences frequent low cloud with periods of extensive rain and drizzle. The presence of sea fog is more common in the summer, with gales occurring during the winter months (DTI, 2003).

Figure 5.5 presents the mean annual wind speed and direction in the area of proposals. Offshore winds are mostly blowing from the southwest (Fugro Metocean Planner, 2025b). Annual mean wind speeds were found to be between 5.1 m/s and 12.8 m/s. Stronger winds occur more frequently during the winter months. However, wind speeds on some occasions during the summer, have been reported reaching speeds of nearly 26 m/s.

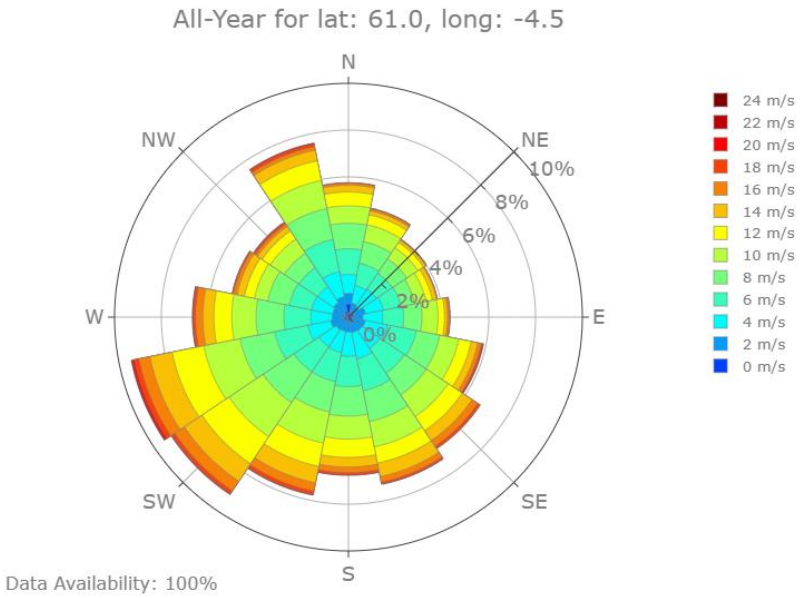


Figure 5.5: Mean annual wind speed and direction in the area of proposals (Fugro Metocean Planner, 2025b)

5.3.3 Bathymetry

The Faroe-Shetland Channel is a deep topographical feature, which is bordered to the southeast by the West Shetland Continental Shelf, to the northwest by the Faroe Shelf and to the southwest by the Wyville Thompson Ridge. The bathymetry within the proposed Cambo field development varies from 1,073 m Lowest Astronomical Tide (LAT) to 1,105 m LAT (Figure 5.6; Fugro, 2025a).

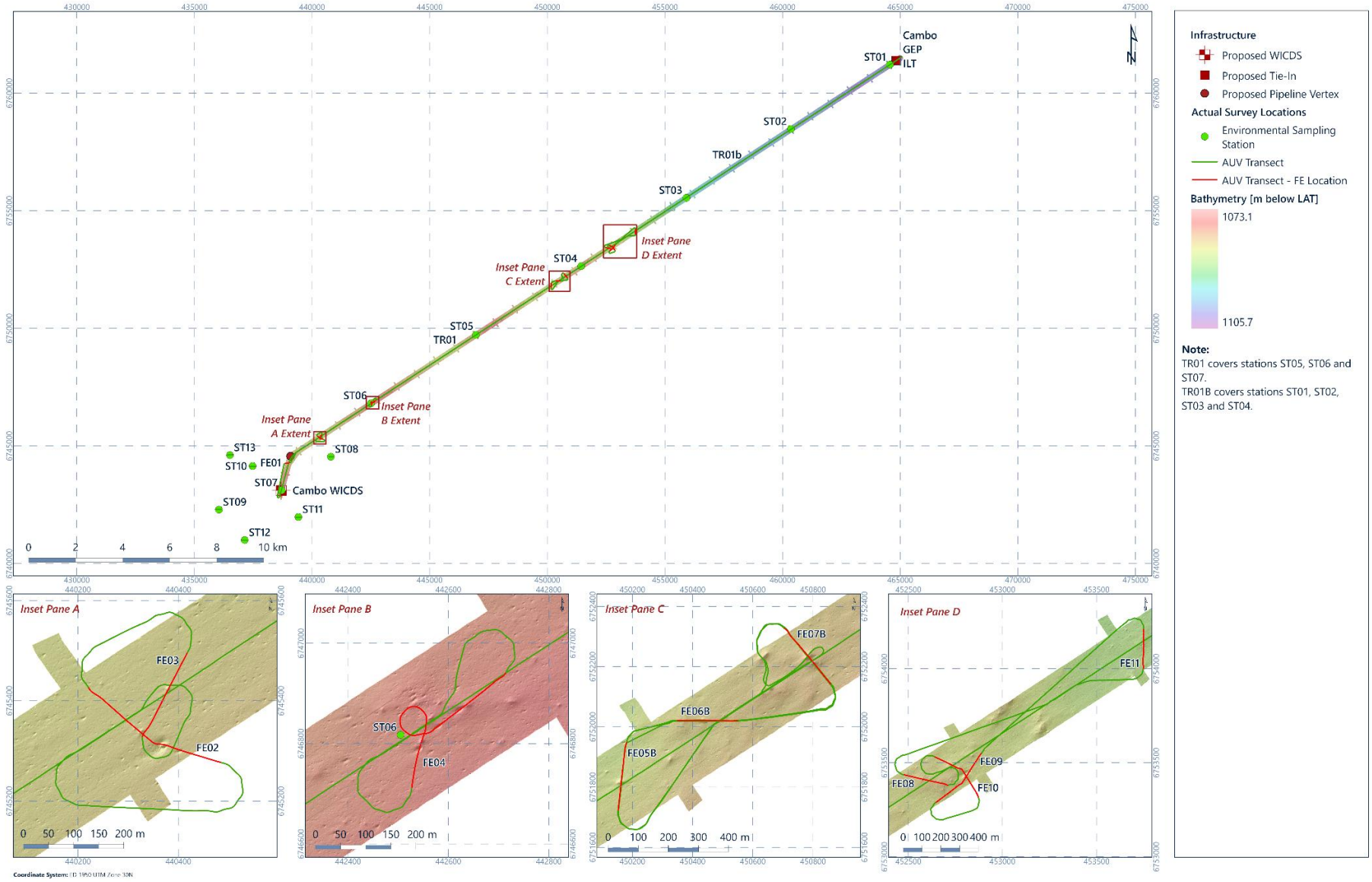


Figure 5.6: Survey area bathymetry and completed environmental sampling locations in 2025 (Fugro, 2025a)

5.3.4 Seabed Features

Iceberg plough marks are a common feature along the edge of the West Shetland Continental Shelf. These generally consist of raised ridges separated by a central depression, resulting from the grounding of floating icebergs during the last glacial period (Masson, 2001). Typical plough marks can be several tens to a few hundred metres in width, with coarse gravel substrate in the ridges and finer grained material in the depressions. The Faroe-Shetland Sponge Belt NCMPA, located 16 km from the proposed Cambo FPSO location, was designated for the presence of iceberg plough marks amongst other features (JNCC, 2020a). Debris fans are present at the base of the continental slope. These are also relicts from the last glacial period and one has been found radiating across the Faroe-Shetland Channel towards the Cambo field development. The distal end of this debris fan was present across the central, east and southeast of the Cambo field. The GEP heads northeast, crossing the debris fan deposit. The seabed elsewhere across the Faroe-Shetland Channel area is relatively smooth and featureless.

Numerous other glacial features, such as drop-stones and scouring, are found throughout the wider area. Seabed depressions and sediment mounds are also prevalent and are thought to have formed due to the action of strong bottom currents known to exist in the area. This is supported by data from previous environmental surveys around UKCS Quadrant 204 (Fugro, 2011a; Fugro, 2011b; Lloyd's Register, 2018) (Figure 5.7).

5.3.5 Seabed Sediments

The distribution of seabed sediments across the wider region of the proposed Cambo field development is presented in Figure 5.8.

The sediments in the region were shaped during the last glacial period, during which there were high sediment deposition rates, in contrast to the low sediment input and deposition rates that feature today. Seabed sediments show a general decrease in grain size with increasing water depth, from mixed sand and gravel in the upper continental slope to mud in the deeper basins of the Faroe-Shetland Channel (Masson et al., 2003).

Regional survey work conducted to the West of Shetland observed that the superficial seabed sediments of the continental slope were mostly sands with some gravel and mud, and typically form a layer of 5 cm to more than 20 cm thickness. The proportion of fine sediment grains (mud) generally increases with water depth, whereas sediments in the deepest areas, below approximately 800 m, contain a significant mud fraction, with muddy sands and pebbly muddy sands dominating (AFEN, 2000). As the Faroe-Shetland Channel narrows towards the southwest, the seafloor may be characterised as gravelly sand with cobbles and boulders, indicative of an increased current flow regime and near-seafloor base rocks (Bett, 2000). The outer continental shelf consists of gravel, overlain by mobile sand bedforms and iceberg plough marks (Masson et al., 2003). Figure 5.8 shows that the seabed sediments within the footprint of the proposed Cambo field development typically comprise mud or sandy mud whilst the GEP traverses mixed sediments, sand and muddy sand and mud and sandy mud (BGS, 2025).

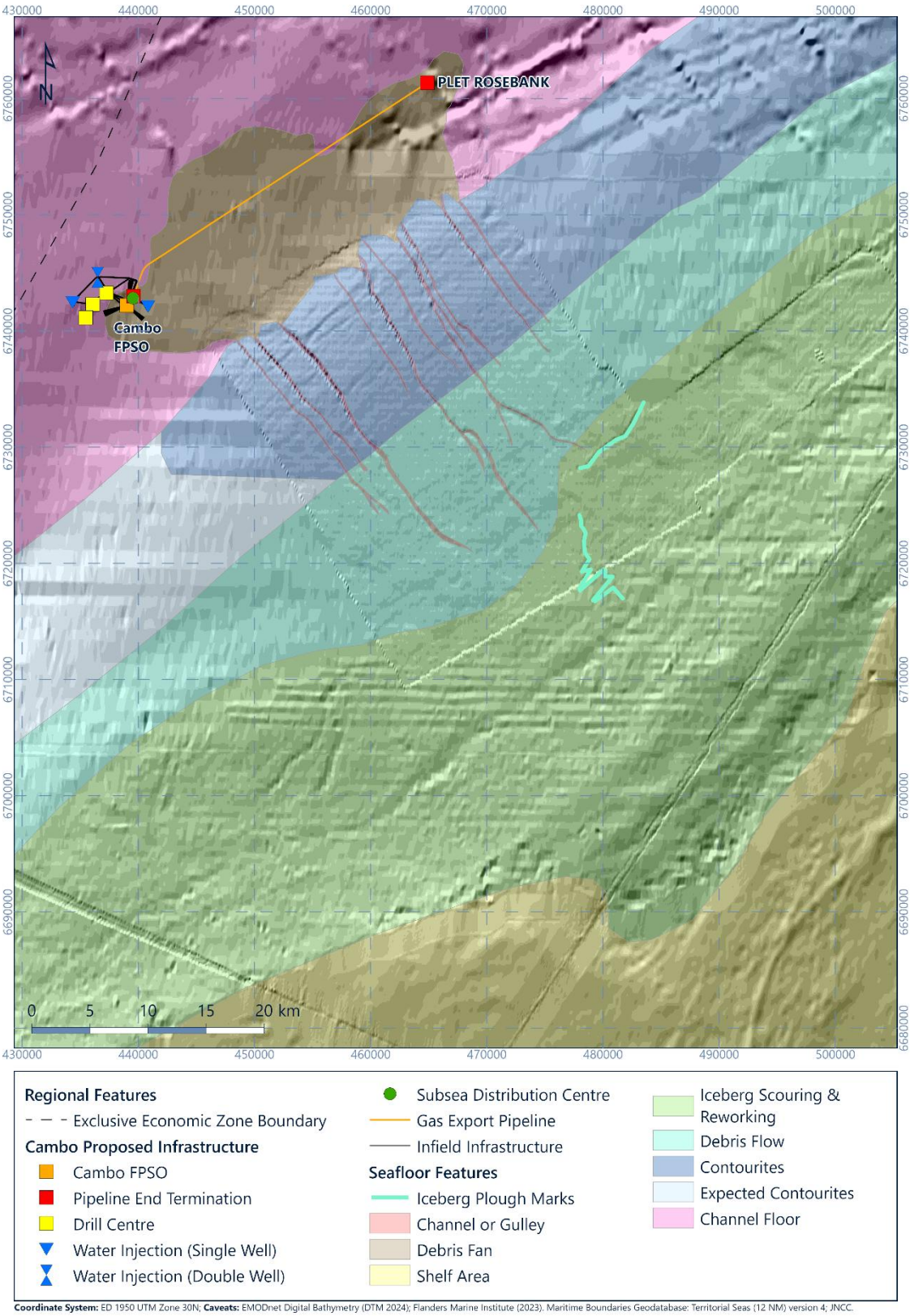


Figure 5.7: Seabed features in the vicinity of the proposed Cambo field development

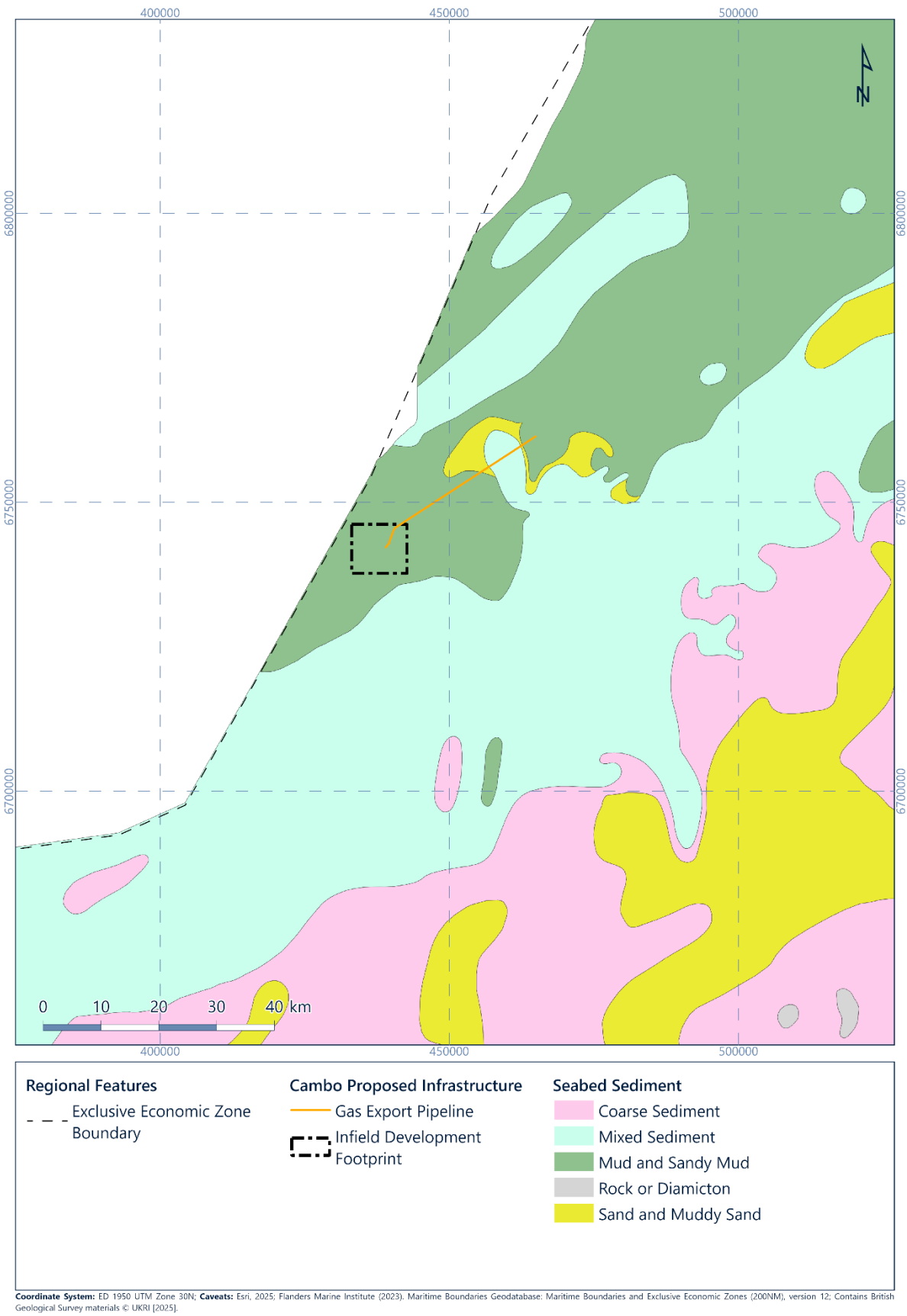


Figure 5.8: Seabed sediments in the vicinity of the proposed Cambo field development

Previous surveys and reports for Cambo indicated the dominance of soft fine sediments with occasionally larger pebbles, cobbles and boulders (Gardline, 2001; Fugro, 2011a; 2011b; 2013; 2017; 2025i; MMT, 2018; Serpent, 2009). These were classified as the EUNIS biotope complex 'A5.45 - Deep circalittoral mixed sediments' (Fugro, 2017) and as 'A6.2 - Deep sea mixed substrata' and 'A6.4 - Deep sea muddy sand' in 2018 (MMT, 2018).

The most recent seabed survey carried out in 2025 (Fugro, 2025a) broadly agreed with previous studies in the area but indicated that the seafloor was largely comprised of mixed sediments, with varying proportions of mud, sand and gravel, alongside some patches of bedrock outcrops of limited extent. These sediment types were classified as the EUNIS habitat types 'Arctic upper bathyal mixed sediment' (ME41) and 'Arctic upper bathyal rock' (ME11).

Figure 5.10 presents the completed environmental transects surveys in 2025 (Fugro, 2025a), overlain on SSS mosaic. Representative images from the 2025 survey are provided in Figure 5.9. Sediments along the FPSO site were dominated by sand (Fugro, 2025d), whereas the sediments observed along the Cambo to Rosebank gas export pipeline route were dominated either by sand or gravel.

Figure 5.9: Image from survey transect TR01B and TR08 showing muddy sand/sandy mud with pebbles, cobbles and boulder

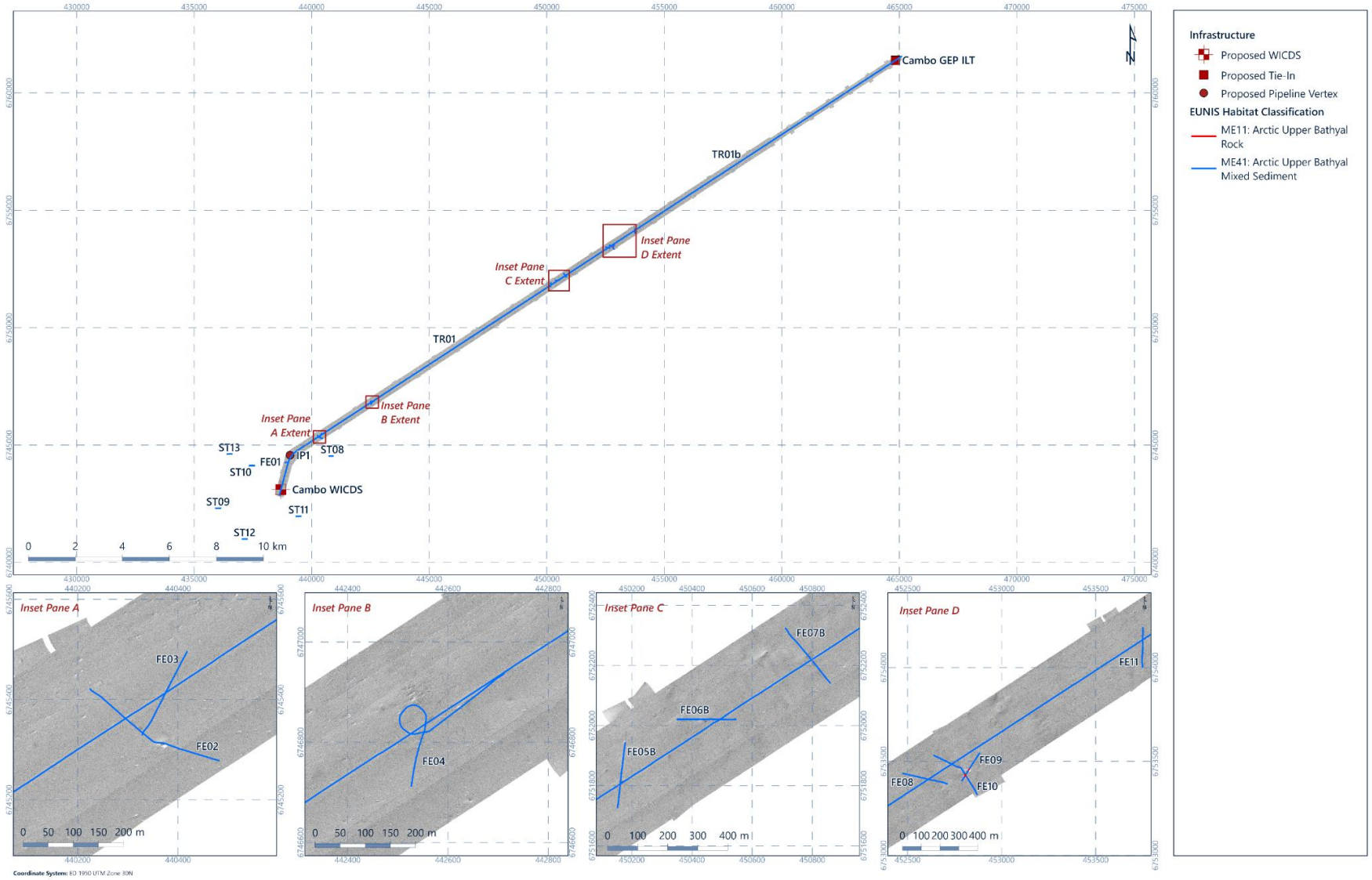


Figure 5.10: Completed environmental transects and EUNIS habitat overlain on a side scan sonar mosaic (Fugro, 2025a)

5.3.6 Sediment Chemistry

5.3.6.1 Heavy metals

Sediment heavy metal concentrations for the area of proposals and wider region are presented in Table 5.2.

Recent survey undertaken in 2025 (Fugro, 2025d) indicated that most metal concentrations were below their respective effect range low (ERL) values, meaning it is unlikely that detrimental impacts to the benthic communities occur. The ERL derived from the OSLO and Paris (OSPAR) Coordinated Environmental Monitoring Programme (CEMP) which uses criteria like background concentrations, risk to the environment, and trends, to assess marine health (2009a). Chromium and copper concentrations exceeded their respective ERL values at most stations sampled. However, given the low to moderate variability observed across all stations sampled (relative standard deviation (RSD) < 40 %; Table 5.2), their concentrations are considered more likely originating from geogenic sources from basic igneous rocks, rather than nearby oil and gas infrastructure (Fugro, 2025a). Moreover, a hydrofluoric acid digestion was used, which accounts for metals within both the available (available for biological uptake by fauna) and unavailable fractions. Therefore, while concentrations may be higher than the ERL values, a proportion of this is unlikely to be available for uptake by biota.

The concentrations reported in 2025 were slightly higher than previous concentrations reported from the region (MMT, 2018; Gardline, 2001; AFEN, 2000).

Table 5.2: Chemical parameters previously sampled in the proposed field development

Survey stats	Al	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Se	Sn	Sr	V	Zn
Cambo (Fugro, 2025d)																
Mean	41,800	7.85	466	0.17	99.4	33.6	38,600	0.03	937	39.1	16.0	-	1.05	455	151	63.1
RSD [%]	23	22	21	35	28	40	38	9	39	24	15		28	38	40	38
MMT (MMT, 2018) *																
Mean	-	3.6	320	0.15	37.9	15.1	21,575	0.01	439	16.4	8.3	-	0.6	232	65.1	37.2
RSD [%]	-	5	4	38	6	12	7	29	4	8	11	-	24	2	4	16
Cambo UKCS 204/10 (Gardline, 2001)																
Mean	-	-	288	-	51	17	-	-	-	-	20	-	-	-	-	43
RSD [%]	-	-	8	-	22	29	-	-	-	-	138	-	-	-	-	25
AFEN 1996 (AFEN, 2000) †																
Mean	-	-	333	-	44	15	-	-	-	27	6	-	-	232	53	29
RSD [%]	-	-	9	-	23	26	-	-	-	16	47	-	-	13	26	19
CEMP Assessment Criteria (OSPAR, 2009a)																
ERL	-	-	-	1.20	81.0	34.0	-	0.150		-	47.0		-		-	150

Notes

Concentrations expressed in µg/g dry sediment

Al = Aluminium As = Arsenic Ba = Barium Cd = Cadmium Cr = Chromium Cu = Copper Fe = Iron

Hg = Mercury Mn = Manganese Ni = Nickel Pb = Lead Se = Selenium Sn = Tin Sr = Strontium

V = Vanadium Zn = Zinc

RSD = Relative standard deviation ERL = Effects Range Low OSPAR = Oslo and Paris Commission CEMP = Coordinated Environmental Monitoring Programme

* = Mean and relative standard deviation calculated from 2018 Cambo survey (MMT, 2018).

† = Mean and relative standard deviation values calculated from stations at similar depths (ranging from 600 m to 1,000 m). Stations used: 53717#1, 53718#2, 53720#1, 53721#1, 53724#1, 53725#1, 53843#1, 53888#2, 53896#1, 53897#2, 53898#2, 53899#2 (AFEN, 2000)

5.3.6.2 Hydrocarbons

Hydrocarbon concentrations are broadly comparable spatially and temporally and are considered typical of background conditions in the West of Shetland region (Table 5.3 and Table 5.4; Fugro, 2025d). Similarly, polycyclic aromatic hydrocarbons (PAH) concentrations are indicative of background levels. Sediment PAHs are representative of both pyrolytic and petrogenic sources (Fugro, 2025d). Pyrolytic sources include incomplete combustion of organic matter at high temperatures (e.g. shipping emissions), whereas petrogenic sources include petroleum, including crude oil, refined fuels, and other oil products (e.g. oil spill).

Table 5.3: Summary of sediment hydrocarbon analysis for the Cambo field development

Survey stats	THC†	UCM†	n-alkanes†			CPI Ratio			Pristane†	Phytane†	Pr/Ph Ratio
			nC_{12-20}	nC_{21-36}	nC_{12-36}	nC_{12-20}	nC_{21-36}	nC_{12-36}			
Cambo (Fugro, 2025d)											
Mean	2.5	1.2	0.11	0.24	0.35	0.89	1.91	1.51	0.0145	0.0065	2.34
RSD [%]	19	24	58	35	42	3	12	11	42	58	12
MMT (MMT, 2018)‡											
Mean	3.9	-	-	-	0.43	-	-	1.58	0.0287	0.0076	5.06
RSD [%]	45	-	-	-	69	-	-	11	110	119	51
Cambo UKCS 204/10 (Gardline, 2001)											
Mean	2.5	2.1	-	-	0.43	-	-	-	0.0121	0.0059	-
RSD [%]	27	32	-	-	28	-	-	-	41	81	-
AFEN 1996 (AFEN, 2000)#											
Mean	2.6	1.6	0.18	0.37	0.56	1.27	1.70	1.54	0.0268	0.0139	2.11
RSD [%]	36	41	43	34	33	24	9	8	36	45	25

Notes
THC = Total hydrocarbon content
UCM = Unresolved complex mixture
CPI = Carbon preference index
Pr/Ph = Ratio of pristane to phytane
RSD = Relative standard deviation
† = Concentrations expressed as µg/g of dry sediment
‡ = Mean and relative standard deviation values from 2018 Cambo survey (MMT, 2018)
# = Mean and relative standard deviation values calculated from stations at similar depths (ranging from 600 m to 1,000 m)

Table 5.4: Summary of sediment aromatic hydrocarbon analysis for the Cambo field development

Survey stats	Total 2 to 6 Ring PAH*	Total US EPA 16 PAH†	NPD	
			Total*	[%]
Cambo (Fugro, 2025d)				
Mean	0.0566	15.8	0.0259	46
RSD [%]	20	19	26	10
MMT (MMT, 2018)‡				
Mean	-	25.48	0.0336	-
RSD [%]	-	66	58	-
Cambo UKCS 204/10 (Gardline, 2001)#				
Mean	-	31.7	0.0297	-
RSD [%]	-	15	21	-
AFEN 1996 (AFEN, 2000)^				
Mean	0.0798	-	0.0363	45
RSD [%]	15	-	27	13

Notes
For statistical evaluation, results < MRV have been taken as absolute values determined by MRV/2
Total 2 to 6 ring PAH = Total 2 to 6 ring polycyclic aromatic hydrocarbons (PAH), including alkyl homologues
Total US EPA 16 PAH = Total United States Environmental Protection Agency's 16 (US EPA PAH) polycyclic aromatic hydrocarbons
Total NPD = Total naphthalenes, phenanthrenes/anthracenes and dibenzothiophenes
NPD [%] = Percentage of total 2 to 6 ring PAH concentration comprised of NPD
RSD = Relative standard deviation
* = Concentrations expressed as µg/g of dry sediment
† = Concentrations expressed as ng/g of dry sediment
‡ = Mean and relative standard deviation values from an environmental survey in Cambo infield area (MMT, 2018)
# = Mean and relative standard deviation values from an environmental survey in Cambo infield area (Gardline, 2001)
^ = Mean and relative standard deviation values calculated from 12 stations with similar depths within the AFEN study. Stations used: 53717#1, 53718#2, 53720#1, 53721#1, 53724#1, 53725#1, 53843#1, 53888#2, 53896#1, 53897#2, 53898#2, 53899#2 (AFEN, 2000)

5.4 Biological Environment

5.4.1 Benthos

Benthos is the term used for animals and plants associated with the seabed, although plants are generally limited by their light requirement to depths of less than 50 m, and are thus not expected on the seabed at Cambo (approx. 1,000 m). Benthic fauna consists mainly of animals that burrow into the sediment or form tubes in it (known as benthic infauna). Other benthic fauna live on the seabed, or attached to rocks or to other biota, are known as benthic epifauna. In general, the main influences on benthic communities are water depth and sediment type although other factors such as sediment stability and temperature, as well as human influences, such as demersal fishing, also play important roles in determining species community distribution and composition.

5.4.1.1 Epifauna

Benthic epifauna, identified along the proposed Cambo pipeline corridor, is sparse. When seabed sediments included muddy sand/sandy mud with pebbles, cobbles and boulders

(assessed as 'Arctic upper bathyal mixed sediment' (ME41); see Section 5.3.5) epifauna was characterised by brittlestars (Ophiuroidea), sponges (Porifera: stalked forms including *Stylocordyla borealis*; carnivorous forms: Cladorhizidae and *Chondrocladia* sp., and glass sponges: possible *Asconema* sp.), starfish (Asteroidea), anemones (Actiniaria and Ceriantharia), featherstars (Crinoidea), sea spiders (Pycnogonida), carnation corals (Capnellidae) and octopuses (Octopoda) (Fugro, 2025a) and are representative of commonly occurring species in the wider region (Gardline, 2001; Fugro, 2011a; 2011b; 2013; 2017; MMT, 2018). Other, less regularly observed, fauna included sea pen (*Umbellula encrinus*), marine leech (*Notostomum leave*), hydroids (possible *Corymorpha* sp.), whelks (Buccinidae) and vampire squid (*Vampyroteuthis infernalis*). Epifauna was poorer when 'Arctic upper bathyal rock' (ME11) habitat was encountered and included sponges (Porifera including possible *Asconema* sp.), carnation corals (Capnellidae), featherstars (Crinoidea) and unidentified faunal turf. Rock-based habitats such as 'Arctic upper bathyal rock' (ME11) did not have infaunal communities, with the exception of burrowing species, which were not observed in the camera data (Fugro, 2025d).

Sporadic burrows were also observed when softer sediments were encountered (Fugro, 2025d).

Rocks and patches of stones on the seabed supported a sparse epifauna and with low or no resemblance to Annex I (European Commission (EC) Habitats Directive) 'Reef'. The observed epifauna included anemones (Actiniaria), sponges (Porifera: carnivorous forms: Cladorhizidae), glass sponges (possible *Asconema* sp.), carnation corals (Capnellidae), starfish (Asteroidea), featherstars (Crinoidea) and unidentified faunal turf (including Hydrozoa/Bryozoa).

Even though sponges and corals were reported along the Cambo GEP route and Cambo infield FPSO site, the qualifying criteria for the OSPAR threatened and/or declining habitats 'Deep-sea sponge aggregations' (and PMF) and 'Coral gardens' were not met, hence the presence of these habitats was ruled out (Fugro, 2025a).

Figure 5.11 presents example AUV pictures obtained from the seabed sediments found within the proposed Cambo field development.

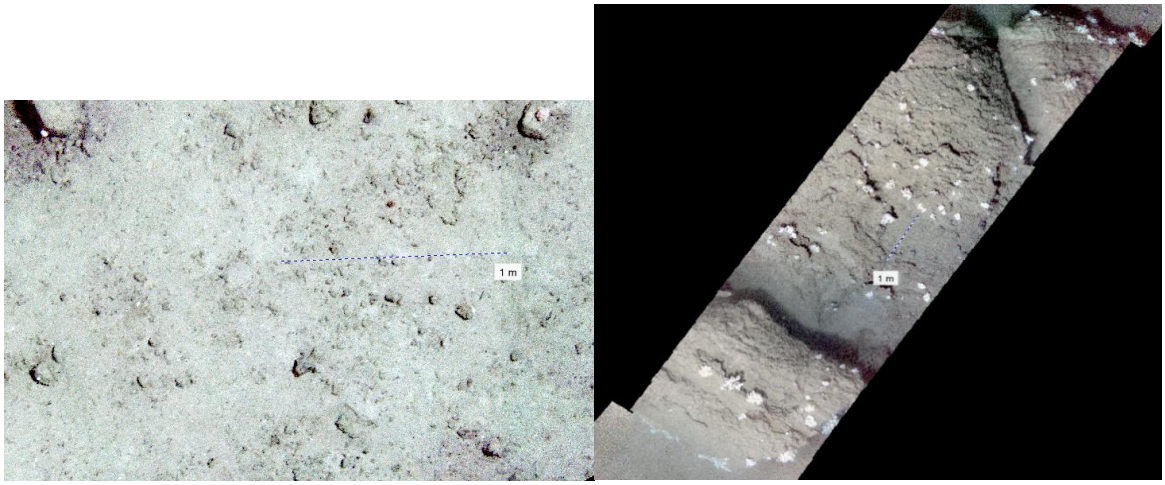


Figure 5.11: Example AUV pictures obtained from the seabed sediments found within the area of proposals (Fugro, 2025a) (muddy sand/sandy mud (left pic) and bedrock (right pic)

5.4.1.2 Infauna

Previous surveys in the area have indicated the dominance of arthropod (crustaceans) and annelids (segmented worms) when the infauna was considered (Gardline, 2001; Fugro, 2011a; 2011b; 2013; 2017; MMT, 2018). Annelids were also recorded to dominate the sediments at Cambo during the 2025 survey (Fugro, 2025d; Figure 5.12).

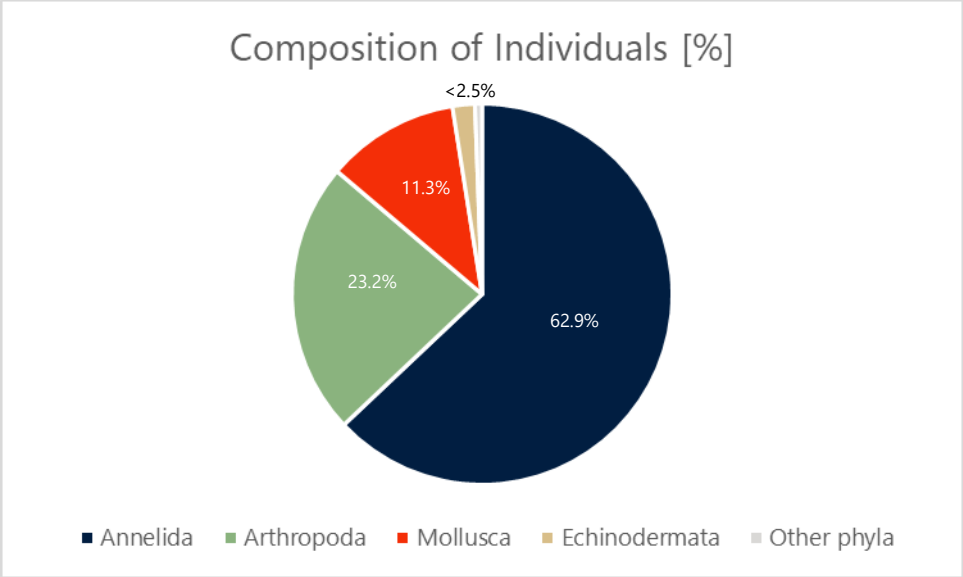


Figure 5.12: Taxonomic groups (Fugro, 2025d)

Some of the most common infauna were the polychaetes *Paramphinome jeffreysii*, *Nephasoma (Nephasoma) lilljeborgi* and *Notoproctus,* which are typical in deep-sea environments of sandy mud in the North Sea and wider North Atlantic (Barnes, 2008; De-Bastos, 2016; WoRMS, 2025) and associated with organic rich sediments (Gunton et al., 2015; Shields & Kedra, 2009).

Phyletic composition of the macrofaunal community across the proposed Cambo field development area was largely homogenous, with no obvious spatial patterns observed. Diversity appeared slightly higher in the Cambo field than the Cambo GEP route. Minor differences in infauna were observed and were likely correlated with sand and total organic matter (TOM) content (Fugro, 2025d). When compared to previous surveys, the infauna in 2025 at Cambo appeared higher than those recorded in the 2018 MMT survey and AFEN surveys (AFEN, 2000) in the region.

5.4.2 Plankton

Plankton consists of microscopic plants (phytoplankton) and animals (zooplankton), including the larval stages of fish and many bottom living animals which drift with the ocean currents. The abundance of plankton is strongly influenced by factors such as water depth, tidal mixing and temperature stratification which determine the vertical stability of the water column; whilst the distribution of species is affected by salinity, temperature, water flow and the presence of local benthic communities.

During spring, an increase in day length and temperature, coupled with the supply of nutrients released during winter mixing of the water column, results in the rapid growth of the phytoplankton population. This phytoplankton bloom is followed by a similarly rapid increase in the zooplankton population, which prey upon phytoplankton. In the Northeast Atlantic, this plankton bloom tends to occur around May (Debes, 2000). Phytoplankton levels drop as the nutrients in the surface waters become depleted and as a result of zooplankton grazing. A secondary phytoplankton bloom occurs in autumn but is less pronounced in the open waters West of Shetland than in the North Sea (DECC, 2004). Diatoms of the genera Chaetoceros and Thalassiosira, and dinoflagellates of the genus Ceratium are the dominant phytoplankton forms in this region of the Northeast Atlantic. Thalassiosira species are more abundant in the West of Shetland area than in the North Sea (Johns & Wooton, 2003).

The zooplankton in the Faroe-Shetland Channel exhibit seasonal and geographical variation in abundance and distribution, to which the over-wintering of animals and food availability are closely linked. Zooplankton distribution is also strongly influenced by the complex hydrodynamic current system present in the area. These currents transport high abundances of copepods (notably Calanus finmarchicus and Calanus helgolandicus) into the area from the Norwegian Sea and the Faroe Shelf (Johns & Wootton, 2003). Currents in the area also produce large upwellings, leading to increased numbers of krill, upon which many fish, seabird and cetacean species feed, and provide migratory routes and nursery areas for planktonic juvenile fish. Krill abundance in the area is steadily decreasing over time (Johns & Wootton, 2003). The zooplankton in this area also includes the larval stages of fish and benthic invertebrates (meroplankton). Soft bodied zooplankton such as salps, may also be abundant, particularly after phytoplankton blooms (Johns & Wootton, 2003).

5.4.3 Fish

5.4.3.1 Fish Distribution

There is comparatively little published information on the biology and distribution of fish populations in the Faroe-Shetland Channel. Much of the data available on the distribution and abundance of fish species in the area comes from commercial fisheries catches and, as such, most of the information presented here is concentrated on commercially significant species. The Faroe-Shetland Channel to the West of Shetland supports a deepwater fishery for species such as blue ling (Molva dypterygia), round-nose grenadier (Coryphaenoides rupestris), orange roughy (Hoplostethus atlanticus), black-scabbard fish (Aphanopus carbo) and a number of deepwater sharks (Barreto et al., 2016).

Data gathered from commercial fish catches and routine fish surveys in the area suggest that there is a vertical zonation of demersal fish communities in the Faroe-Shetland Channel (Figure 5.13). This zonation is maintained by several environmental influences, particularly variation in water temperature and food availability (Bett, 2003). The upper slope zone extends from the shelf edge to approximately 500 m and is characterised by the presence of warm Atlantic derived water. The fish community of this area includes rabbitfish (chimaeras), redfish

(Sebastes spp.), bluemouth rockfish (Helicolenus dactylopterus) and blue whiting (Micromesistius poutassou) (Gordon & Swan, 1997).

Beyond 500 m in depth, water temperatures decline rapidly as warm Atlantic water meets with cold Norwegian Sea water. The sharp temperature gradient supports an unusual fish assemblage dominated by cold water species such as Arctic skate (Amblyraja hyperborea), roughhead grenadier (Macrourus berglax), blue ling, tusk (e.g. Brosme brosme), redfish (Sebastes sp.) and Greenland halibut (Reinhardtius hippoglossoides). A number of unidentified species have also been recorded in this zone (DTI, 2003). Dulvy et al. (2008) have documented that cold water species such as monkfish (Lophius sp.) and megrim (Lepidorhombus whiffiagonis) are moving into deeper waters as a result of ocean warming, which has increased numbers in waters deeper than 500 m.

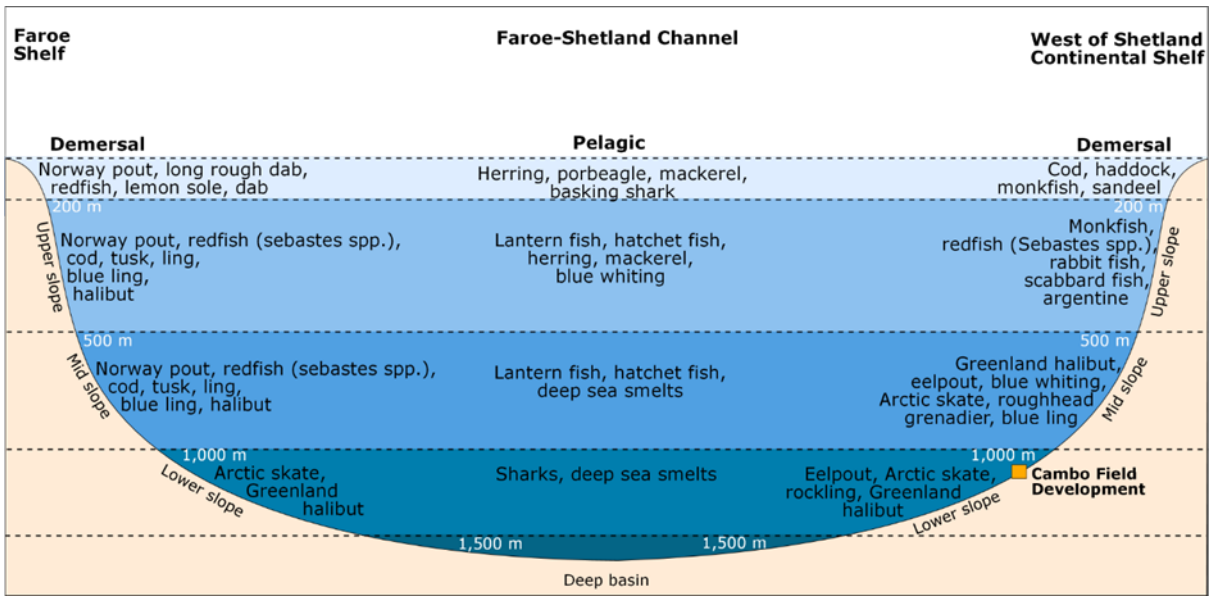


Figure 5.13: Zonation of pelagic and demersal fish assemblage in the Faroe-Shetland Channel (Sources: Gordon & Hunter, 1994)

Below 1,000 m which is the water depth reported for the area of proposals, bottom temperatures are generally less than 0 °C and the water mass present is confluent with cold Norwegian Sea water. This deep-water environment supports comparatively few demersal fish species which are commercially exploited (Gordon & Hunter, 1994). The sparse fauna present includes Arctic skate, rockling, Greenland halibut and deepwater species of eelpout (DTI, 2003).

The distribution of pelagic fish species is similarly influenced by changes in water temperature and food supply. They are often found in large shoals, and typically undergo extensive migrations between feeding, spawning and overwintering grounds. Shoaling pelagic fish, include blue whiting and mackerel (Pinnegar et al., 2010). Little is known about mesopelagic species, some of which can be very abundant, and it is thought that the dominant fish species to the west of the UK are the light-emitting lantern-fish (Myctophidae) and the pearlside (*Maurolicus* sp.) (Pinnegar et al., 2010; DECC, 2016). The snipe-eel (Nemichthyidae), dragonfish (Stomiidae) and lantern-fish have been reported in mid-water surveys, and it is thought that

some of these species have extended their range around the UK. Large ocean wanderers such as the dealfish (*Trachipterus arcticus*) and the bony fish oarfish, have occasionally been washed up on UK coasts (Pinnegar et al., 2010).

5.4.3.2 Spawning and Nursery Grounds

Extensive survey programmes have been used to predict the broad distribution of spawning grounds for a range of commercially important fish and shellfish species in UK waters (Coull et al., 1998). For many of these species, this has been supplemented by more recent data collation and review by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) (Ellis et al., 2012). Spawning areas are not rigidly fixed, changing with the prevailing environmental conditions. Moreover, information on deepwater fish spawning and nursery grounds is limited. However, some fish species have a high age of maturation and in combination with the sparsity of life in the deep sea, adult fish are aggregating at certain sites to spawn, usually around seamounts (DECC, 2016).

Within the proposed Cambo field development, no spawning grounds have been identified based on existing information (Coull et al., 1998; Ellis et al., 2012). However, the area overlaps with blue whiting high intensity nursery grounds (CEFAS, 2010). Predicted spawning grounds for blue whiting are also found approximately 10 km to the west (Figure 5.14; Coull et al., 1998; Ellis et al., 2012). Peak spawning for blue whiting occurs between February and May (Ellis et al., 2012).

Most fish species release large numbers of eggs directly into the water column, over a wide area. Fish hatch quickly from their eggs, and many remain in the water column as larvae. The dispersal of fish eggs and larvae is largely dependent upon water circulation patterns. However, as fish develop, they tend to concentrate in localised nursery areas, either within the water column or on the seabed, where feeding opportunities and protection from predators are greatest. Species such as Norway pout (*Trisopterus esmarkii*) and cod (*Gadus morhua*) spawn in the water column were the eggs and larvae are dispersed by currents.

The developing eggs, larvae and juveniles of blue whiting drift and migrate through the Faroe-Shetland Channel to the Norwegian Sea, at a depth of around 300 m to 400 m (Hatun et al., 2007). A return migration to the breeding grounds then occurs in November and December (Jákupsstovu, 1996). Blue whiting has been designated as a Scottish Priority Marine Feature (PMF) which are of conservation importance in Scotland's seas (NatureScot, 2020). Some of the species designated as PMFs have been included in the list, as a significant proportion of their population occur, or have a functional role in Scotland's seas, not necessarily due to whether they are under threat or in decline.

No other PMF species were previously identified within the area of proposals (Fugro, 2013; 2025a).

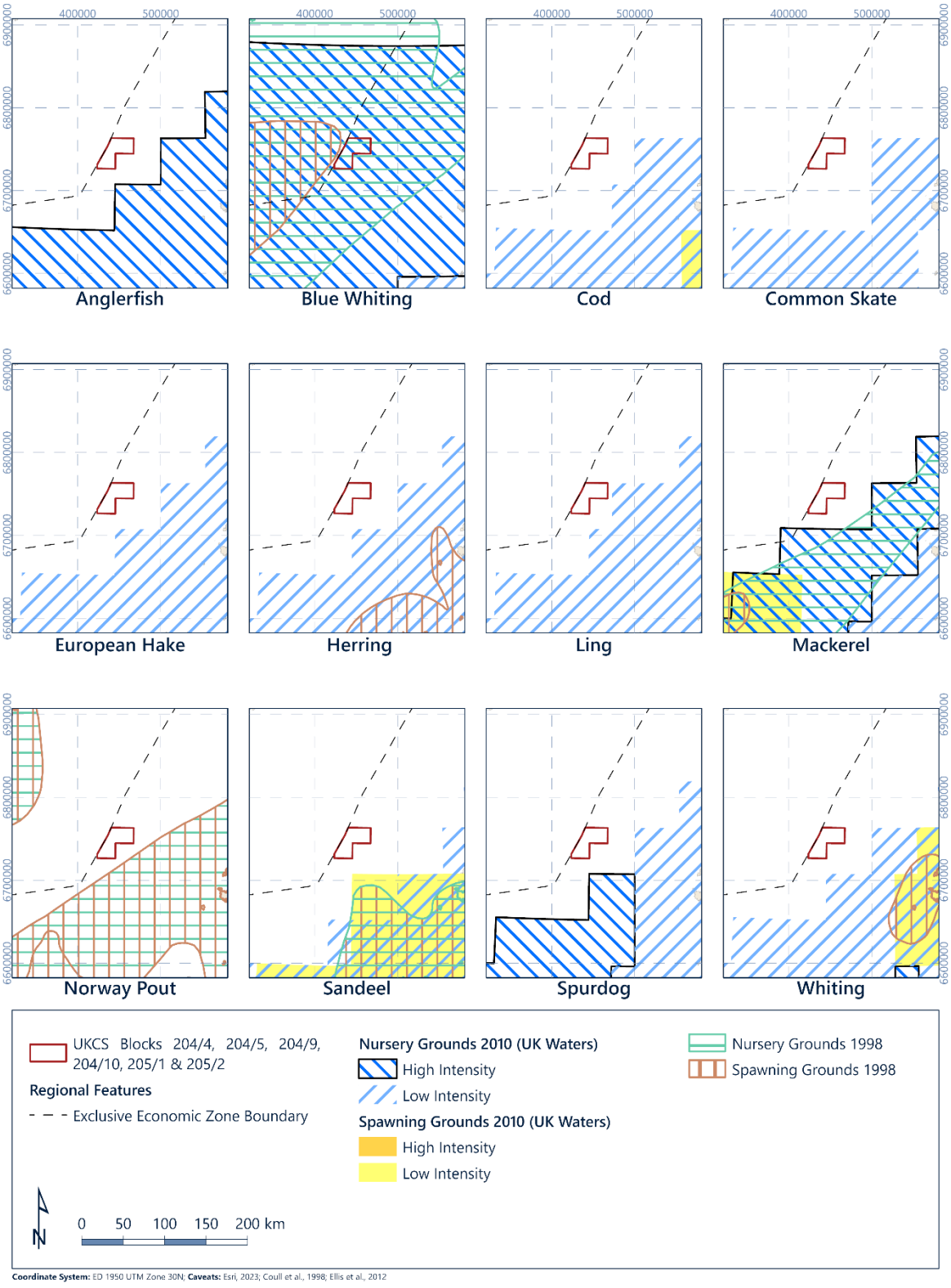


Figure 5.14: Fish spawning and nursing areas in the area of proposals

5.4.3.3 Elasmobranchs (Sharks and Skates)

There are several elasmobranch species found in the waters around the British Isles, several of which occur in the Faroe-Shetland Channel. Of those the ones that are most likely to be present within the area of proposals are presented in Table 5.5.

The porbeagle shark (*Lamna nasus*) (OSPAR and PMF listed) occurs in the waters around Shetland and is thought to be present all year round in deepwater off the Faroe Islands (DTI, 2003). Blue sharks (*Prionace glauca*) are known to follow the North Atlantic Drift through the Faroe-Shetland Channel towards the Norwegian Sea (Kohler et al., 2002). Thresher sharks (Alopiidae) have also been recorded in these waters but only in low numbers (Ebert & Stehmann, 2013). The porbeagle, blue and thresher shark feed on pelagic herring and mackerel shoals and are regular, though not abundant, visitors to these northern latitudes during summer months (DECC, 2016).

The basking shark (*Cetorhinus maximus*) (which is PMF and OSPAR listed) is widely distributed throughout the waters of the UK west coast, including the Faroe-Shetland Channel (Marine Directorate, 2024). Basking shark sightings are most frequent between April and September (Hayes et al., 2018). Basking sharks spend most of their time on the continental shelf, traveling widely between areas of high productivity, characterised by tidal fronts and fronts associated with the shelf break. This behaviour may explain variations in public sightings (Sims et al., 2005).

The blackmouth catshark (*Galeus melastomus*) (PMF listed) is typically found over the continental slope and it's abundant in the Eastern Atlantic, at depths of 150 to 1,400 m, on or near muddy bottoms. Information on this species within the Faroe-Shetland Channel are sparse. However, according to NAMMCO (2017), nursery areas for this species are found along the shelf break around the Faroe Plateau, west and north of Scotland, the Norwegian Deep, and to the west of Norway and the species is reproducing throughout the year (Costa et al., 2005).

The leafscale gulper shark (*Centrophorus squamosus*) (PMF and OSPAR listed) is widely distributed in the Atlantic at water depths up to 2,400 m (Ebert & Stehmann, 2013). The species is migratory with pre-pregnant and spent females being reported as present in this part of the Atlantic (Moura et al., 2006.) The gulper shark (*Centrophorus granulosus*) (OSPAR listed) is also present in this part of the Atlantic (Marine Directorate, 2024).

The Portuguese dogfish (*Centroscymnus coelolepis*) (PMF and OSPAR listed) inhabits continental slopes and abyssal plains, on or near the seabed at depths between 270 and 3,700 m (OSPAR, 2009b). Vertical migration of females is considered taking place to give birth in shallower waters, which exposes individuals to fishing industry hence notably impacting negatively their numbers (OSPAR, 2009b).

The Arctic skate (*Amblyraja hyperborea*) is one of the most abundant fish species in the deep waters of the Faroe-Shetland Channel. Individuals inhabit water depths ranging from about

600 m to 1,500 m. This species forms a portion of discarded by-catch from the deep-sea fishery (Fowler et al., 2004).

Table 5.5: Shark and skate species likely present within the area of proposals based on existing literature

Species	Conservation Status in North Atlantic
Porbeagle	OSPAR and PMF listed
Basking shark	PMF and OSPAR listed
Blackmouth catshark	PMF listed
Gulper shark	OSPAR listed
Leafscale gulper shark	PMF and OSPAR listed
Portuguese dogfish	PMF and OSPAR listed
Arctic skate	None in UK waters

No elasmobranch species were recorded in previous surveys undertaken within the area of proposals. The thorny skate (*Amblyraja radiata*) was recorded at Rosebank in 2009 (Serpent, 2009).

5.4.3.4 Cephalopods

There are a number of cephalopod species found in the waters around the British Isles, among the most frequently recorded species within the Faroe-Shetland Channel are the long-finned squid, the short-finned squid and spoonarm octopuses (DECC, 2016). Other species may occasionally be encountered in the region. The deepwater octopuses are widespread throughout the deep, cold waters of the North Atlantic, down to depths of 2,500 m. However, little is known about the ecology of these predatory species.

Cephalopods are short-lived molluscs, characterised by rapid growth rates, and are important predators and prey in oceanic and coastal environments. Cephalopods are frequently seen as a major dietary component for many marine mammals. The long-finned squid is the main cephalopod species of economic importance within the Faroe-Shetland Channel (Pierce et al., 2003). However, the amount landed from the area round the proposed field development is very small (Marine Directorate, 2025c).

5.4.4 Marine Mammals

5.4.4.1 Whales, Dolphins and Porpoises

The waters of Faroe-Shetland Channel support a number of important and diverse populations of marine mammals, whose distributions are governed primarily by water depth and availability of preferred food sources. A confluence of ocean currents results in upwelling waters rich in food, enabling several species to live in the area throughout the year.

Cetaceans can be very difficult to view at sea and can only be detected during the very short amount of time they spend on the surface. Visual surveys can only be conducted reliably in conditions of good visibility, during daylight hours, and in a limited range of sea states. This is especially limiting during the autumn and winter seasons, due to the poor weather conditions

and reduced daylight hours. Many species, however, make loud and distinctive vocalisations and can often be detected more readily using passive acoustic systems, rather than by visual means. For this reason, passive acoustic techniques are being increasingly used in cetacean survey work, enhancing the information available on cetacean distribution.

Species which regularly occur in the Faroe-Shetland Channel and have been detected either visually, or acoustically, include, the Atlantic white-sided dolphin (*Lagenorhynchus acutus*), killer whale (*Orcinus orca*), long-finned pilot whale (*Globicephala melas*), fin whale (*Balaenoptera physalus*), and sperm whale (*Physeter macrocephalus*). Harbour porpoise (*Phocoena phocoena*), common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), and white-beaked dolphin (*Lagenorhynchus albirostris*), as well as Northern bottlenose whale (*Hyperoodon ampullatus*), sei whale (*Balaenoptera borealis*), and minke whale (*Balaenoptera acutorostrata*), are also recorded to a lesser extent. Some species of baleen whale, such as blue whale (*Balaenoptera musculus*) and humpback whale (*Megaptera novaeangliae*), are occasionally observed (DECC, 2016). Cetaceans, including blue, fin, sei and sperm whales, are thought to use the Faroe-Shetland Channel as a migratory pathway, swimming through the area to summer feeding grounds in the north, before returning to more southern overwintering and breeding grounds (JNCC, 2014; Macleod et al., 2006; Reid et al., 2003). Bottlenose dolphins (*Tursiops truncatus*) have also been reported in the Faroe-Shetland Channel, but they are considered to inhabit coastal waters, hence are unlikely to be present within the area of proposals.

All cetaceans that occur in UK waters are protected under the EU Habitats Directive, which makes it an offence to deliberately capture, kill or recklessly disturb cetaceans. All cetacean species are listed on Annex IV and many of the cetacean species present in the Faroe-Shetland Channel have also been designated as PMFs in Scotland (NatureScot, 2020). Harbour porpoise and blue whales are OSPAR listed (OSPAR, 2025a) and harbour porpoise is also listed on Annex II (Marine Directorate, 2017).

The presence of cetaceans within the Faroe-Shetland Channel is summarised in Table 5.6.

Table 5.6: Distribution and abundance of whales, dolphins and porpoises in the Faroe-Shetland Channel

Species	Cetacean Distribution and Abundance
Harbour porpoise	The harbour porpoise is common in shelf waters, with fewer records from deeper waters such as those around the proposed field development. They have been observed in the Faroe-Shetland Channel and may be more abundant in deepwater than surveys suggest, as they are difficult to detect in rough sea states. They have been recorded within the wider area, most frequently observed between April to September.
Risso's dolphin	Risso's dolphins form groups of up to approximately ten individuals. Although often regarded as an offshore species preferring deeper continental slope waters, most sightings around Scotland have occurred over the shelf. Sightings in deep waters are generally between July and December.
White-beaked dolphin	Widely distributed on the continental shelf to the West of Shetland and Orkney but is rare in deeper waters. Most frequently observed between June and October in UK waters. Generally found in groups of less than ten individuals, although they have been observed in larger aggregations.
White-sided dolphin	This species is often recorded in the deeper reaches of the Faroe-Shetland Channel and is regularly sighted in large pods numbering in the tens to hundreds. White-sided dolphins are seen year-round in the Faroe-Shetland Channel with peaks in sightings between May and October.
Common dolphin	This species is an occasional summer visitor to the Faroe-Shetland Channel. It is thought that their presence in the Channel results from following squid, their preferred food source.
Minke whale	Most sightings of minke whales occur within the 200 m depth contour but there have been sightings in the Faroe-Shetland Channel. This species is resident in UK shelf waters, with peak sightings occurring from May to October.
Sperm whale	Found on and beyond the continental shelf break and may be present all year round. The highest densities are observed in deeper waters, and they have been sighted in low numbers in the waters adjacent to the area of proposals during the summer months. The species can be seen in groups of tens of individuals. Evidence suggests that only males migrate to northern latitudes to feed, therefore it is assumed that the channel is a migratory route for some of the population.
Killer whale	This species appears to be present in the Faroe-Shetland Channel all year round, but sightings increase during summer. Most sightings have been undertaken in offshore waters, with occasional sightings around the Faroe Islands. Most UK sightings have been of individuals or groups of less than eight animals.
Long-finned pilot whale	Most long-finned pilot whale sightings occur along the shelf break and in the deeper waters of the Faroe-Shetland Channel. Sightings peak during the summer, especially July and August. Surveys to the north and West of Scotland have recorded an average pod size of just over ten. The species has been observed in low numbers in the region where the area of proposals falls within.
Northern bottlenose whale	This beaked whale has been recorded throughout much of the Faroe-Shetland Channel, with the channel representing an important part of their habitat. However, sightings of the species are low. The species are thought to migrate north through the channel in spring returning in the autumn.
Fin whale	Fin whales are mainly seen in deeper waters off the continental shelf edge. Most sightings have been reported between May and October, with a peak in sightings in August. Passive acoustic monitoring has shown the whales to be present year-round.
Blue whale	This is a very rare species, although acoustic monitoring has shown that individuals do occur in the deepwater of the Channel during autumn and spring. Most acoustic detections take place during November and December, and sightings are rare.

Species	Cetacean Distribution and Abundance
Sei whale	Sei whales migrate between summer northern feeding grounds and lower latitude overwintering grounds. They arrive in Scottish waters between April and July, leaving late August and September. A peak in sightings has been reported in August.
Humpback whale	Considered relatively rare, humpback whales have been regularly reported from recent sightings and acoustic detections within the Channel. There have been few sightings along the shelf break, with most during summer but they may be present in the region all year round. Generally seen singly or in pairs, rarely exceed groups of four or five. They migrate annually from high latitude, cold water, feeding grounds in summer to low-latitude, warm water, breeding grounds in winter.
Notes Sources: BEIS, 2022a; Bloch et al., 2000; Charif & Clark, 2009; DECC, 2016; Evans & Harvey, 2019; Gilles et al., 2023; Hammond et al., 2006; Hammond et al., 2021; Paxton et al., 2016; Pollock et al., 2000; Reid et al., 2003; Swift et al., 2002; Waggitt et al., 2019.	

Cetacean presence and density in the area of proposals and wider region have been assessed through species distribution models at 10 km resolution and monthly scale, developed through the collation and standardisation of survey data collected in the North-East Atlantic between 1980 and 2018 (Waggitt et al., 2019), and have been summarised in Table 5.7.

Table 5.7: Density of species of cetaceans within and immediately surrounding the Cambo field development

Species	J	F	M	A	M	J	J	A	S	O	N	D
Fin whale	3	3	3	3	3	-	-	-	-	-	-	3
Killer whale	1	1	1	1	1	1	2	2	2	2	1	1
Long-finned pilot whale	2	2	2	2	2	2	2	2	2	2	2	2
Minke whale	3	3	3	3	3	3	-	-	-	-	3	3
Risso's dolphin	-	-	-	-	-	-	3	3	3	3	-	-
Sperm whale	2	2	2	2	2	2	2	2	2	2	2	2
Atlantic white-sided dolphin	2	2	2	2	2	2	2	2	2	2	2	2
Key	-	Not present		3	Low		2	Moderate		1	High	
Notes: Sources: Waggitt et al., 2019.												

A geophysical survey undertaken in 2018 within the Cambo field documented the presence of long finned whale, Atlantic white-sided dolphin, white-beaked dolphin, and fin whale (MMT, 2018). Additionally, long finned pilot whale, Atlantic white-sided dolphin, minke whale, fin whale, sei whale and possible humpback whale sightings were reported during the Tornado to Tormore site survey undertaken in UKCS Blocks 204/13 to 205/5a in June and July 2024 (Fugro, 2024), which is approximately 20 km east from the proposed field development area.

5.4.4.2 Seals

Harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) are resident in Scottish waters. They are typically found in coastal waters shallower than 200 m and are present in internationally important numbers around Shetland and Orkney. The grey and common seal are listed under Annex II of the EC Habitats Directive and are both designated as PMFs in Scottish waters (EEA, 2019a; 2019b; NatureScot, 2020).

Grey Seal

Approximately 34 % of the world's population of grey seals breeds on the UK coastline. Of these, 70 % breed in Scotland, with main aggregation sites located in the Western Isles, Orkney, and fast-growing colonies in the central and southern North Sea (SCOS, 2024). They utilise outlying islands and remote coastlines as moulting, pupping and general haul out sites. The Island of Foula and its colony of grey seals is the closest sea haul-out location to the proposed field development, found approximately 133 km to the southeast.

Grey seals spend a high proportion of their time ashore during their pupping and moulting seasons (Hammond et al., 2001). Grey seal pups are born from September to late November in northern Scotland and annual moulting typically occurs from December to April (SCOS, 2024).

Satellite tracking has shown that grey seal foraging trips can extend several hundred kilometres offshore, but most foraging tends to occur within 100 km of a haul-out site. Individual seals based at a particular haul-out site will often make repeated trips to the same offshore locations using prominent corridors (Jones et al., 2015; SCOS, 2024). It is estimated that grey seals spent 12 % of their time at distances greater than 50 km from the coast (Jones et al., 2015).

Figure 5.15 shows estimates of the expected mean number of seals within a 5 km x 5 km grid covering the maximum foraging range of seals from haul-out sites in the UK and Ireland (Carter et al., 2025). As the field development site is located beyond the typical foraging range of grey seals, they are not expected to be encountered within or close to the location of the proposed Cambo field development.

Harbour Seal

The UK is home to approximately 30 % of the European population of harbour seals, 85 % of which is found in Scotland (SCOS, 2024). The species is widely distributed in Scottish waters (including the Orkney and Shetland Islands; NatureScot, 2024) with main aggregation being located on the west coast. Haul-out, breeding, and moulting sites are typically situated in sheltered estuaries and on sandbanks, as well as rocky areas.

Harbour seals spend a high proportion of time ashore during the pupping and moulting seasons from June to August (SCOS, 2024). During the pupping season hauled-out groups tend to be smaller and more dispersed (Duck, 2007).

Telemetry studies of harbour seals have observed that foraging trips are generally within 40 km to 50 km of haul-out sites. Although longer trips of over 200 km have been observed, these were between haul out sites, rather than to offshore foraging areas (Jones et al., 2013). It is estimated that harbour seals spend only 3 % of their time at greater distances than 50 km form the coast (Jones et al., 2015). Their estimated distribution is also demonstrated in Figure 5.15, reflecting the estimated mean number of seals present within the field development footprint (Carter at al., 2025).

This data shows that harbour seals are unlikely to be found within or close to the area of the proposed field development, as the site is located beyond their typical foraging range.

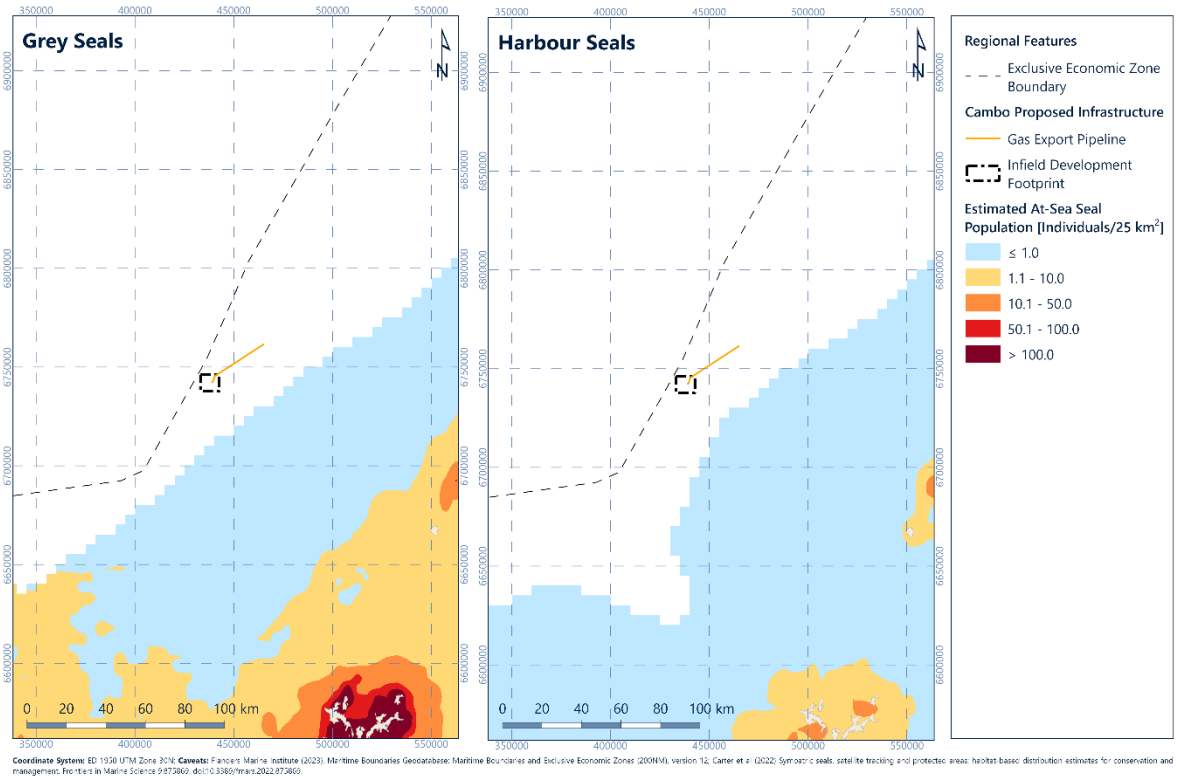


Figure 5.15: Estimated mean number of seals in the vicinity of the Cambo field development

Hooded Seal

Hooded seals (*Cystophora cristata*) regularly visit the waters of West of Shetland in autumn and winter (Figure 5.16; Pollock et al., 2000). This species prefers deepwater, making repeated dives to depths of over 1,000 m, and sightings have been predominantly recorded in the deep Faroe Shetland Channel (Bloch et al., 2000). Satellite telemetry data show that a proportion of the stock moves down to forage in the Faroe-Shetland Channel, mainly over deep waters (Hammond et al., 2003). Hooded seals are thought to feed primarily on demersal prey such as Greenland halibut, redfish and cod (Hammill et al., 1997). Hooded seal numbers found in the Faroe-Shetland Channel are low overall (Pollock et al., 2000). The species is listed under Appendix III of the Convention on the Conservation of European wildlife and natural habitats (Bern Convention) and the Conservation of Habitats and Species Regulations 2017.

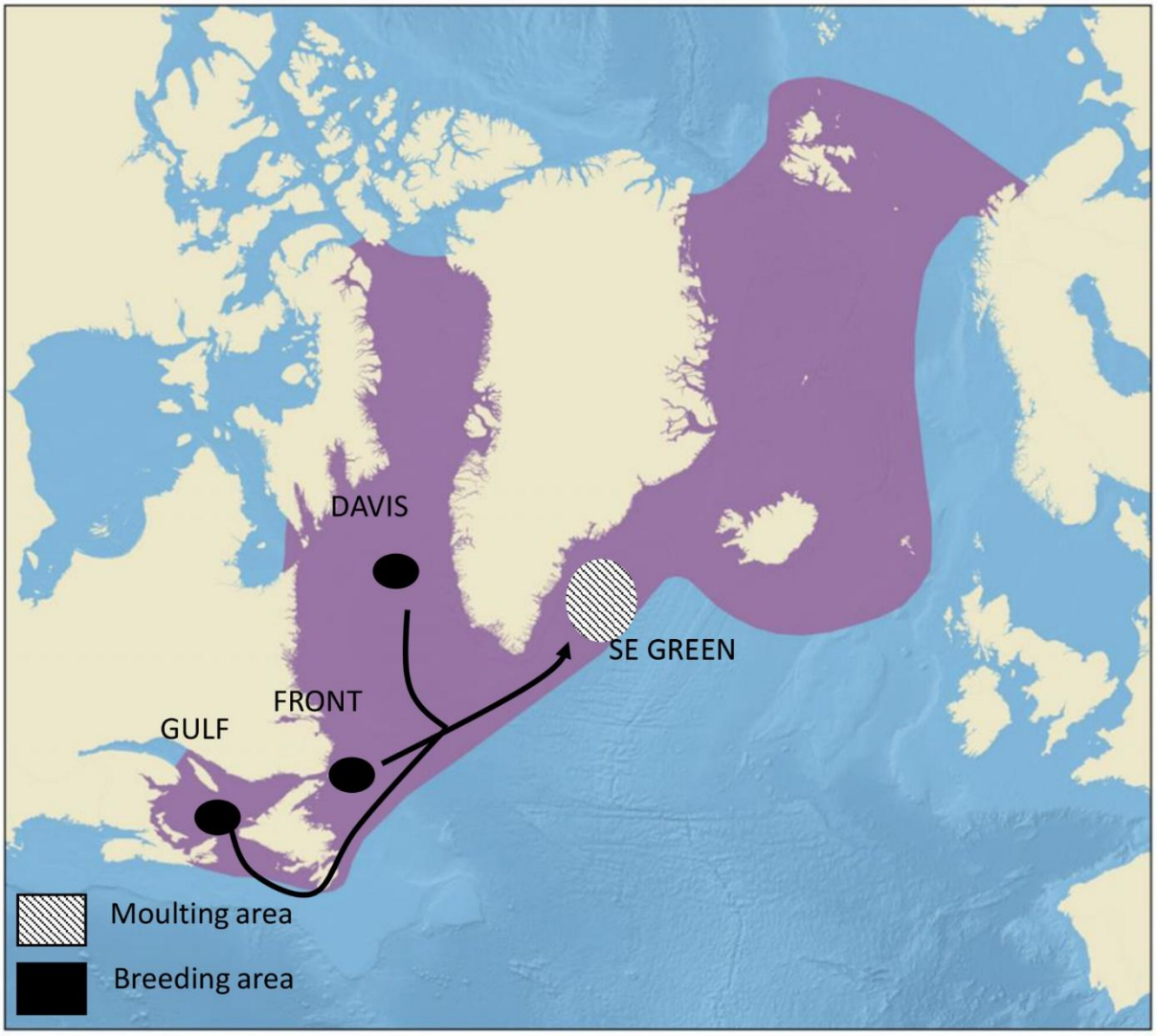


Figure 5.16: Hooded seal range (source: NAMMCO, 2021)

5.4.4.3 Otters

The common otter is a semi-aquatic mammal, which utilises both inland freshwater and coastal areas. It is estimated that around half of the Scottish otter population uses shallow marine areas to feed. These animals, however, only use a relatively narrow strip of sea, extending to around 80 m from land (Kruuk & Moorhouse, 2006). Within this zone, they show preferences for areas of bedrock or cobbles and boulders, foraging in areas with a dense covering of seaweed. Foraging ranges can be up to 5 km of coastline due to the productive inshore waters providing abundant fish and crustacean prey (SNH, 2015).

A series of surveys undertaken by the Vincent Wildlife Trust, examined the distribution and status of otters in Scotland (Green & Green, 1997; Findlay et al, 2015). These surveys demonstrated that this animal had strongholds in the Highlands, the Hebrides, and Shetland Islands, but had undergone a decline in the central belt and parts of southeast Scotland. Since 2003, Scottish Natural Heritage (SNH) (now known as NatureScot) has continued to collect data on the distribution of otters and examine trends in their abundance (Findlay et al, 2015;

Strachan, 2007). The otter population on the Shetland Isles is recognised as being exceptional in terms of the high density of animals and their signs.

Areas of the Yell Sound, on the northern coast of Shetland, are believed to support more than 2 % of the entire UK otter population (JNCC, 2025). This region is characterised by low-lying peaty coastlines with large numbers of otter holts and easy access to freshwater. The adjacent marine areas have extensive seaweed beds which they use for foraging. Otters are afforded protection under the EC Habitats Directive, and this site has been designated as a Special Area of Conservation (SAC), primarily for its otter population (Section 5.6). Otters are also UK Biodiversity Action Plan (UKBAP) priority species and PMF in Scotland (NatureScot, 2020). Otters are also known to occur along the shores of Sullom Voe, and in the large firths which dissect the island of Yell (Strachan, 2007). Shetland otters are morphologically and genetically distinct from those found on the mainland and are, therefore, considered to be of special importance in a UK context. The offshore location of the proposed Cambo field development makes it unlikely that any otters will be present within the field development area.

5.4.5 Seabirds

The Orkney, Shetland and Faroe Islands and their surrounding waters are sites of major international importance for the seabird colonies they support. Approximately 25 species of seabird regularly breed in the UK and Ireland as do several other waterbirds (BEIS, 2022a). These birds breed on the coasts of the UK, with some feeding far offshore. In winter, seabirds become less attached to their nesting sites and travel considerable distances in search of food.

Although some seabird species may forage in the area during breeding season, the Faroe-Shetland Channel is considered to be too far offshore for most species to reach during this time (BEIS, 2022a). Most seabirds encountered in the area are generally non-breeders and birds passing through to reach their breeding grounds in spring and autumn (BEIS, 2022a).

Distribution and abundance of seabird species vary seasonally and annually. Table 5.8 summarises potential presence of seabird species in the vicinity of the Cambo field development area during breeding, moulting, and wintering seasons (Kober et al., 2010).

Seabirds are present throughout the year in the Faroe-Shetland Channel, with mostly low to moderate densities found in the proposed field development area (Kober et al., 2010; Waggitt et al., 2019). The most common seabird species likely to occur within the Cambo field development area is northern fulmar (*Fulmarus glacialis*), which is present in high densities between October to February. Other commonly encountered species include great skua (*Stercorarius skua*), European storm petrel (*Hydrobates pelagicus*), black-legged kittiwake (*Rissa tridactyla*), and Atlantic puffin (*Fratercula arctica*). Some additional species that may be present in the area at lower densities are northern gannet (*Morus bassanus*), arctic skua (*Stercorarius parasiticus*), Leach's storm petrel (*Hydrobates leucorhoa*), Manx shearwater (*Puffinus puffinus*), sooty shearwater (*Ardenna grisea*), common gull (*Larus canus*), glaucous gull (*Larus hyperboreus*), great black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), lesser

black-backed gull (*Larus fuscus*), arctic tern (*Sterna paradisaea*), little auk (*Alle alle*), common guillemot (*Uria aalge*), and razorbill (*Alca torda*).

During breeding season, generally between May and June, large numbers of seabirds congregate in coastal breeding colonies. Numerous breeding sites are present along the coastline of the Orkney and Shetland Islands for several seabirds (JNCC, 2025; Kober et al., 2010). Notable seabird breeding sites around the Faroe-Shetland Channel include Foula, Sumburgh Head and Hermaness, Sax Vord and Valla on the Shetland Islands and West Westray and Calf of Eday on the Orkney Islands (JNCC, 2025).

Table 5.8: Seabirds likely present within the proposed Cambo field development

Species	J	F	M	A	M	J	J	A	S	O	N	D
Northern fulmar	Fulmars are the most abundant and widespread species in the proposed field development area. During breeding season, March to July, moderate to high densities of fulmar have been observed over deepwaters. Birds disperse more widely into offshore waters in the autumn and winter.											
Northern gannet	Gannets are widespread throughout and are present in the area year-round. This species becomes less common in winter months as the majority of immature birds migrate south. Birds return north to breed during the spring.											
Arctic skua	Densities of Arctic skua are highest when the species returns from overwintering in the south during May. Breeding takes place during May to August with higher densities inshore.											
Great skua	The great skua is widespread at moderate densities during the breeding season in the summer months, but it is present year round at low densities.											
European storm petrel	The regional population of this species is generally present year round, with the highest numbers sighted over the deeper water of the Faroe-Shetland Channel between June and October. The species migrates south over the winter months.											
Leach's storm petrel	A highly aerial species which has a widespread distribution West of Shetland, but is usually sighted over deeper waters of the Faroe-Shetland Channel in the summer, prior to departing to winter areas in the tropics.											
Manx shearwater	During the breeding season, between May and September, Manx shearwaters may be present along the Faroe-Shetland Channel.											
Sooty shearwater	From June to November, the sooty shearwater migrates from eastern America to the Atlantic for breeding. The species cross the deep-waters to reach feeding grounds on the continental shelf.											
Black-legged kittiwake	Kittiwakes are the most abundant and widespread gull species. During the breeding season birds remain near their colonies whilst non-breeding birds are found at moderate densities the offshore area over the winter period.											

Species	J	F	M	A	M	J	J	A	S	O	N	D
Common gull												
	Common gulls are recoded in small numbers throughout the year over the Faroe-Shetland Channel.											
Glaucous gull												
	The glaucous gull is a winter visitor occurring from October to March. Birds are generally concentrated over the Faroe-Shetland Channel.											
Great black-backed gull												
	The great black-backed gull is widely dispersed year-round, although during the breeding season it stays close to breeding colonies inshore.											
Herring gull												
	Herring gulls are primarily coastal, especially during the breeding season between April and August. This species is present offshore over the winter months while it migrates to its wintering areas offshore west and north of Shetland.											
Lesser black-backed gull												
	Lesser black-backed gull is widespread at low densities, although they usually aggregate in inshore waters for most of the year.											
Arctic tern												
	Densities are highest in the inshore waters around Orkney and Shetland, during breeding season from May to August. Distribution is patchy in deeper waters but birds have been recorded returning to more northerly colonies in May.											
Little auk												
	Low densities were recorded in the Faroe-Shetland Channel from November to March. Little Auks are most common in December as this is a major wintering ground for this species.											
Atlantic puffin												
	Non-breeding puffin are found offshore in deeper areas during the breeding season whilst adults congregate in colonies. Puffins are most widespread in deep-waters between August and March, with low densities offshore during the summer.											
Guillemot												
	The guillemot prefer waters less than 100 m deep, but are also found in low densities in the Faroe-Shetland Channel year-round.											
Razorbill												
	Razorbills are primarily a shelf species. There are localised areas of low densities have been recorded in deeper water beyond the shelf break during the winter period.											
Key		Not present		Low		Moderate		High				
Notes Sources: BEIS, 2022a; Kober et al., 2010; Waggitt et al., 2019.												

Seabirds are generally not at risk from routine offshore oil and gas production operations (JNCC, 2020b). However, they may be vulnerable to pollution from less regular offshore activities such as well testing and flaring, when hydrocarbon dropout to the sea surface can occasionally occur, or from unplanned events such as accidental oil or diesel releases.

Seabird vulnerability within/around the Blocks of interest has been assessed according to the JNCC's Seabird Oil Sensitivity Index (SOSI). The purpose of this index is to identify areas where

seabirds are likely to be most sensitive to oil pollution by considering factors making a species more or less sensitive to oil-related impacts.

The SOSI uses seabird survey data collected between 1995 and 2015, in addition to individual species sensitivity index values, combined at each location to create a single measure of seabird sensitivity to oil pollution (Webb et al., 2016). The SOSI combines the seabird survey data with individual seabird species sensitivity index values. These values are based on a number of factors, which are considered to contribute towards the sensitivity of seabirds to oil pollution, and include:

- habitat flexibility (the ability of a species to locate alternative feeding grounds);
- adult survival rate;
- potential annual productivity; and
- the proportion of the biogeographical population in the UK (classified following the methods developed by Certain et al. (2015).

The combined seabird data and species sensitivity index values were then subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution.

Median sensitivity for the wider region is shown in Figure 5.17 and Table 5.9. The sensitivity of birds to surface oil pollution is generally between 'low' and 'medium' for UKCS Blocks 204/4, 204/5, 204/9, 204/10, 205/1, and 205/2 throughout the year, with a peak in sensitivity reported in September (Webb et al., 2016). The majority of surrounding UKCS Blocks are also considered to be between 'low' and 'medium' sensitivity, increasing to 'high' in early spring and 'extremely high' in autumn, likely due to coinciding with seabirds moving through the Faroe-Shetland Channel to reach their breeding grounds (BEIS, 2022a; Webb et al., 2016).

Table 5.9: Seabird sensitivity to surface oil pollution in the vicinity of the Cambo field development

UKCS Blocks	J	F	M	A	M	J	J	A	S	O	N	D
Blocks Overlapping with the Proposed Field Development												
204/4	5	5*	5*	5	5	5	5*	5	1	5	5*	5
204/5	5	5*	5*	5	4	4	5	5	1	5	5*	5
204/9	5	5	5	4	5	5	5*	5	2	5	2	5
204/10	5	5	4	4	5	4	5	5	1	5	5*	5
205/1	5	5*	4*	4	3	5	5	5	3	5	5	5
205/2	5	5*	5*	5	4	5	5	5	5	5*	5	5
Blocks of the Immediate Vicinity												
204/14	5	4	5	4	4	5	5	5	5	5	3	5
204/15	5	5	5	4	5	4	5	5	5	5	2	5
205/3	5	5*	5*	5	4	5	5	5	5	1	5	5
205/6	5	5*	5	4	4	5	5	5	3	5	5	5
205/7	5	3*	3	4	3	5	5	5	5	4	5	5
205/8	5	3*	3	5	3	5	5	5	5	3	5	5
205/11	5	5	5	4	4	4	5	5	5	5	3	5
212/30	5	5*	5*	5	5	3	4	5	1	5	5*	5
213/26	5	3*	3	4	5	5	4	5	2	2*	5	5
213/27	5	3*	3	5	5	5	5	5	4	4*	5	5
213/28	5	5*	5	5	5	5	5	5	5	5*	5	5

Notes
1 – Extremely High, 2 – Very High, 3 – High, 4 – Medium, 5 – Low and ND – No Data
* - Indicates blocks for which no data was available, and therefore score has been calculated using that of an adjacent month or Block
Source: Webb et al., 2016.

Of the species expected to occur in the area, the European storm petrel, the Leach's storm petrel and the arctic tern are protected under the EC Birds Directive (Annex I), whilst the black-legged kittiwake is included in the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR, 2025a).

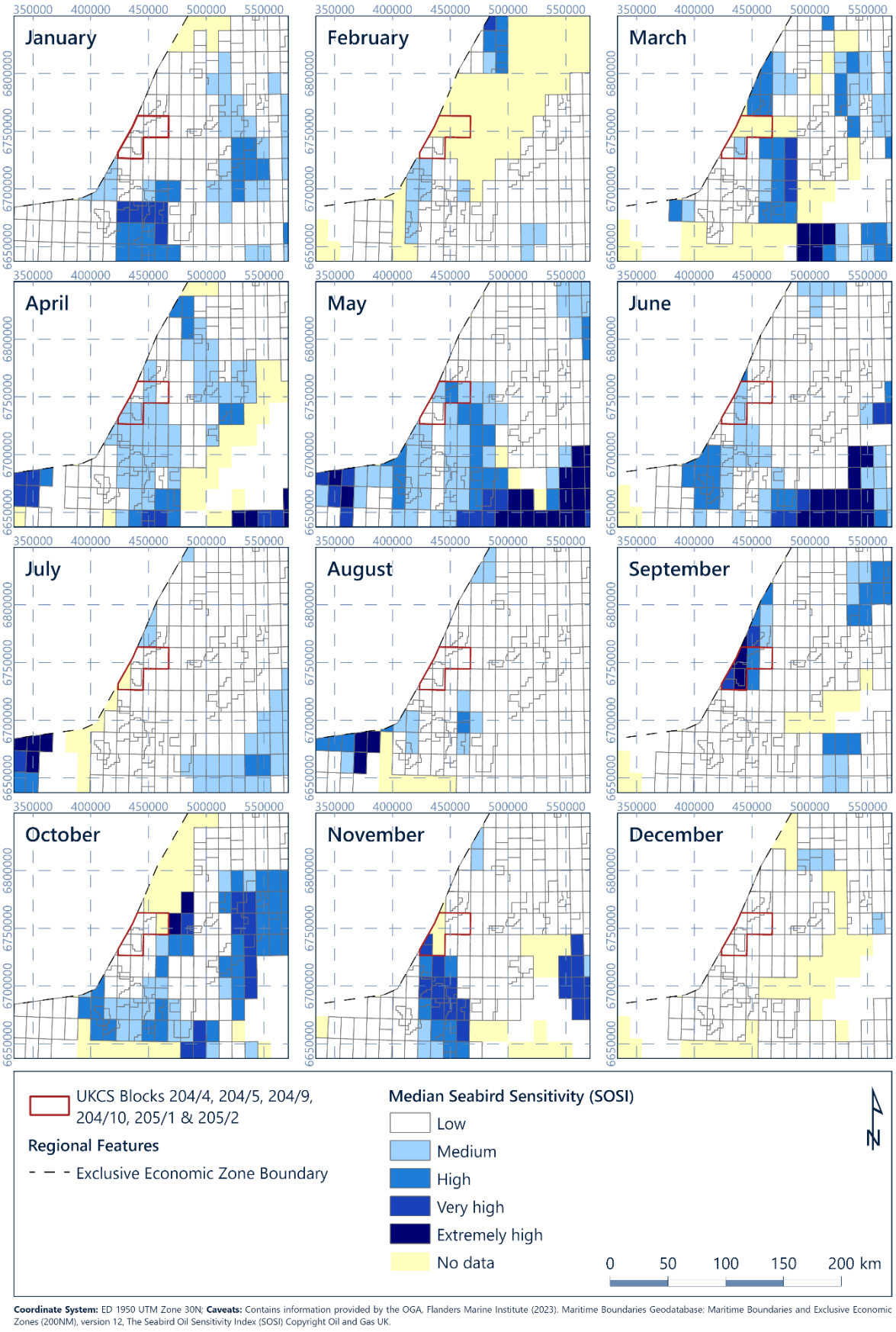


Figure 5.17: Seabird sensitivity to surface oil pollution in the vicinity of the Cambo field development

5.5 Coastal Habitats

Oil spill modelling has been conducted to inform the assessment of potential impacts from hydrocarbon spills associated with the proposed Cambo field development (see Section 14). This modelling indicates that under typical climactic conditions, a hydrocarbon spill may reach the coastlines of the Scottish mainland, Shetland Islands, Orkney Islands, Faroe Islands, Norway and Iceland. The characteristic coastal habitats encountered in the areas identified are discussed below.

5.5.1 Shetland and Orkney Islands

The nearest UK land mass to the proposed Cambo field development are the Shetland and Orkney Islands. The Cambo FPSO lies approximately 133 km west of the Shetland Islands and approximately 172 km from the Orkney Islands. Both the Orkney and Shetland islands are archipelagos consisting of numerous islands with extensive and complex coastlines supporting a range of different habitat types, including rocky habitats, sandy and muddy shores, and voes.

5.5.1.1 Rocky Habitats (including Shingle Beaches)

Rocky shores are formed from hard substrates and can include different habitat types such as bedrock platforms, boulder fields, rock pools and cliffs. Sea cliffs are steep rock faces formed by erosion but they can show great diversity of form, from very tall vertical or near-vertical cliff faces, through long, steep slopes with a vertical face restricted to the base, to low cliffs above intertidal rock platforms (Dargie, 1997).

The majority of the Shetland coastline is characterised by either sea cliffs or exposed rocky shores (Shucksmith, 2017). Cliff coastlines on Shetland primarily consist of tall vertical cliffs although steep headlands, caves, arches and stacks are present too (BEIS, 2022a; Dargie, 1997). Sea cliffs are extensively distributed throughout the Shetland Islands but are slightly more prevalent on the western side of the mainland and they provide critically important habitats for seabird breeding colonies (Dargie, 1997; Shucksmith, 2017). The reduced intertidal areas are typically characterised by attached invertebrate species such as barnacles and mussels. Sheltered rocky shore areas are generally dominated by the egg wrack, *Ascophyllum nodosum* and other brown seaweeds. Very exposed areas are dominated by barnacles, limpets and mussels (Howson, 1998).

The coastline of the Orkney archipelago is more diverse than that of Shetland and is generally characterised by a low profile. However, exposed steep sandstone cliffs and stacks dominate the western shores of some of the islands (NatureScot, 2019). Smaller lengths of cliff habitats are also distributed around to the east and north coast. The enclosed waters of Scapa Flow are largely surrounded by bedrock and rocky shorelines (Barne et al., 1997). The sheltered rocky shore areas around Orkney are dominated by brown seaweed communities, accounting for just under half of all the Orkney coastline, giving way to more invertebrate dominated communities as the wave environment becomes more exposed (Howson, 1998).

Shingle features are formed from the accumulations of pebbles ranging from 2 mm to 20 cm in diameter. Shingle is generally deposited as fringing beaches running along a coastline or as forelands, spits and barriers formed by opposing wave actions. If the shingle is stable enough it can provide a foundation for plant communities to develop, further stabilising the habitat. Vegetated shingle is characterised by rare, specialised plant species adapted to the exposed, low nutrient conditions. Shingle also provides important habitat for ground-nesting seabirds and terrestrial invertebrates.

Small areas of vegetated shingle beaches, sometimes backed by coastal lagoons, are found on Shetland, particularly in the voes and firths of the northwest mainland and Yell. This represents less than 0.5 % of the total Shetland coastline. As much of the shingle is heavily exposed, the associated plant communities are sparse except for in the sheltered part of voes and other features. The more extensive areas of shingle provide some locally important breeding areas for Arctic terns and ringed plovers (Randall, 1997). There are also considerable lengths of shingle on Orkney including spits and barrier beaches formed from the local red sandstone. Shingle on Orkney provides breeding habitats for fulmars along with Arctic and common terns (Randall, 1997). Some of these shingle barriers form coastal lagoons. Overall, the shingle habitat represents 2.5 % of the total Orkney coastline.

5.5.1.2 Sedimentary Habitats (Sandy and Muddy Shores Including Saltmarshes)

Sandy shorelines comprise beaches formed from loosely accumulated sandy, gravelly or shelly sediments. Muddy beaches, comprised of finer, more closely associated sediments, are only found in areas with calm wave conditions. The intertidal zone of sedimentary shores is primarily colonised by burrowing infaunal communities, including polychaete worms such as lugworms and ragworms and bivalve molluscs such as cockles and razorshells. These communities provide an important food resource for other organisms, particularly juvenile fish and waterbirds.

Shetland's coastline is characterised by bays, inlets and sounds (Shucksmith, 2017). These areas are sheltered from wave and wind exposure and sedimentary shores are relatively common within them. Although gravelly, sandy and muddy areas are found along the coastline, sedimentary shores on Shetland typically consist of coarse sands and gravels (Shucksmith, 2017; University of Aberdeen & Hartley Anderson, 2003). Intertidal benthic communities in coarser, shelly sediments are characterised by the bivalve *Macoma balthica* along with the polychaetes *Fabricia sabella* and *Tubificoides benedeni*. Finer sediments typically support the bivalves *Macoma balthica* and *Crenella decussata*, the polychaete *Travisia forbesii* and the isopod crustacean *Eurydice pulchra* (Irving, 1997a). Some of the bays around the Shetland Islands are backed by sand dune systems and machair (sandy grassland) although sand dunes are limited in number and extent due to the lack of sand supply (Shucksmith, 2017).

On the main island of Orkney, there are numerous sandy shores backed by dunes and machair. In general, the group of islands to the north of the mainland have complex coastlines of rocky headlands and shallow sheltered bays supporting stable, sandy shores. In particular, the island

of Sanday supports notable sandy beach areas, consisting of extensive sandy bays backed by dune and machair systems including two large intertidal sheltered embayments (Murray et al., 1999). The sedimentary areas around Orkney typically consist of "clean" sediments (low organic content) and support intertidal benthic communities dominated by amphipod crustaceans and polychaete worms such as the sand mason worm, *Lanice conchilega* (Howson, 1998; Irving, 1997b).

In the most sheltered of intertidal areas, where very fine sediments accumulate, saltmarshes may be found. Saltmarshes provide essential habitats for migratory and overwintering birds. On Shetland, saltmarshes are found mainly at the heads of voes and other inlets, covering approximately 0.2 % (2.5 km) of the available coastline (Hill, 1997a). Most saltmarsh areas are found on mainland Shetland, but there are a few sites on Unst and Yell.

Small patches of saltmarsh habitats are also distributed around the Orkney Islands in very sheltered areas, although this amounts to less than 1 % (3.5 km) of the total Orkney coastline (Hill, 1997b). Saltmarshes are concentrated in the sheltered bays and strands of Scapa Flow (particularly on Hoy), the northeast coast of Mainland and Sanday.

5.5.1.3 Voes, Houbs and Vadills

The Shetland coast is indented by a series of features, including inlets known locally as "voes". Voes are narrow, steep-sided sea inlets formed from river valleys flooded by historical sea level rise, similar to fjords or sea lochs. Voes support a range of habitat types, such as exposed, steep bedrock shores and cliffs, generally followed by more gentle and sheltered bedrock and boulder areas. Sedimentary shores are found at the heads of voes. The heads of voes can also support brackish lagoon systems known as known as 'houbs' - pools with a shingle ridge across the mouth, and 'vadills' - bays with narrow rocky entrances (Barnes & Bamber, 1997). Voes, houbs and vadills provide sheltered habitats, with the seabed grading from rock to coarse shelly sand to mud.

5.5.2 UK Mainland

The north coast of mainland Scotland, along with the coast of Moray and Aberdeenshire, predominantly features steep-sided cliffs with headlands, caves, geos (an inlet, a gully or a narrow and deep cleft in the face of a cliff), blowholes and stacks cut into granite, sandstone and limestone (BGS, 1996; Dargie, 1996). These areas are high energy environments resulting in rocky shorelines. More sheltered inlets around the Kyle of Durness and Kyle of Tongue feature sandy beaches with shallow sand flats.

The Inner Moray Firth is less exposed, but with tidal effects that have transported shingle and sandy sediments to form banks on both coasts of the Firth (BGS, 1996). The sheltered inlets of the Dornoch Firth, Cromarty Firth and the Inner Moray Firth are lower energy environments where sand and shingle spits and barriers can form, with extensive intertidal sand flats, backed in some places by mudflats and saltmarshes.

The cliffs along the Aberdeenshire coastline are interspersed with sheltered areas where sandy beaches are present, backed by extensive sand dune systems and machair. A few very small mud flats and saltmarshes are also present along the Grampian coast (Hill, 1996).

5.5.3 Faroe Islands

The Faroe Islands lie around 152 km northwest of the Cambo FPSO. They comprise 18 major islands, divided by a series of northwest to southeast running sounds (Hansen & Mortensen, 2025). The major islands are characterised by steep sea, accompanied by inlets and fjords, with small islands, stacks and skerries (Hansen & Mortensen, 2025). These islands are characterised by exposed rocky shores with little intertidal zone, some sandy beaches, but almost no areas of soft, muddy sediment (PAME, 2017).

5.5.4 Norway

The nearest landfall on the Norwegian coast to the Cambo FPSO location is over 468 km to the east. The western coastline of Norway is characterised by a network of deep, steep sided fjords, and numerous small, rocky islands and islets. Coastal habitats are dominated by steep cliffs and by rocky shores (WOR5, 2017). Sand and mud habitats are restricted to sheltered areas away from strong tides. Sandy beaches also fringe some of the coastal islands, particularly in the northern part of the country. Mudflats and saltmarshes are very limited and are restricted to inner reaches of the fjords (Marthinsen et al., 1992).

5.5.5 Iceland

Iceland is located over 663 km northwest of the Cambo FPSO. The coastline of Iceland is characterised by hard bare rock pavement sloping towards the coast and deep fjords forming steep cliffs and rocky shores, with little intertidal zone (AMS, 1952). Numerous rocky islands are also present and sedimentary coastlines are also common around Iceland. Direct glacial outwash has resulted in extensive gravel beds, particularly in the south of the island (AMS, 1952). These have been reworked via current action to create spits and barrier islands. Extensive mud flats and saltmarshes have developed on the lee side of these barriers, and in the sheltered inner parts of fjords. Sandy beaches are present in smaller fjords where wave action is more severe. In general, low energy, sedimentary habitats are present in the south, west and far northeast of the island, whilst cliffs and rocky shores are most prevalent along the east coast (AMS, 1952).

5.6 Protected Sites and Sensitive Habitats

5.6.1 Coastal Conservation Areas

There are numerous protected sites along the coastlines of the Shetland and Orkney Islands, which are located adjacent to the area of proposals (Figure 5.18). These include internationally designated Ramsar Sites (internationally important wetlands of importance, especially for waterfowl), Special Protection Areas (SPAs) and Important Bird Areas (IBAs) (protecting rare and vulnerable species of wild birds), and SACs (EC Directive (92/43/EEC) for the Conservation

of Natural Habitats and Wild Flora and Fauna 1992 (The Habitats Directive)). There are also numerous nationally designated sites, including Sites of Special Scientific Interest (SSSIs).

The Shetland and Orkney Islands possess many habitats that are either of major conservation importance in themselves or for the species they support. As such, many sites are afforded protection under both statutory and non-statutory conservation designations. The Shetland and Orkney Islands are of international ornithological significance, particularly as seabird breeding sites, and as such many coastal sites on the islands are designated as SPAs and IBAs (Figure 5.18). Ronas Hill – North Roe and Tingon on Shetland and the East Sanday Coast on Orkney are also classified as a Ramsar sites (Ramsar, 2025). Hermaness, Saxa vord and Valla Field is designated as a SPA for its breeding populations of red-throated diver (*Gavia stellata*), gannet, great skua, and puffin. The island of Foula was also designated as a SPA for its breeding populations of Arctic tern, Leach's storm-petrel, red-throated diver, great skua, guillemot, puffin, and shags (*Phalacrocorax aristotelis*), together with its seabird assemblage of international importance (JNCC, 2025). Inshore waters adjacent to seabird colonies are used heavily by seabirds during the breeding season; this has been reflected in the recent seaward extension to breeding colony SPAs. Several SPAs around the Shetland Islands have been extended by up to 2 km (JNCC, 2025). Some SPAs on the islands have also been selected for the presence of rare divers and overwintering waders which are concentrated near to shore or on the shoreline.

There are also a number of SAC designated for habitats and species on the Shetland and Orkney Islands (Figure 5.18). Important habitats designated as SACs include the extensive sea cliffs at Hoy on Orkney, shallow inlets and bays found in Sullom Voe, coastal lagoons in Vadills and reefs and submerged or partially submerged sea caves of Papa Stour on the Shetland Islands (JNCC, 2025). SACs have been established for the major common seal breeding sites at Sanday on Orkney and in the Yell Sound and Mousa on Shetland as well as for the second largest grey seal colony in the UK at the islands of Faray and Holm of Faray on Shetland (Paterson et al., 2015; JNCC, 2025). The Yell Sound coast is also designated due to its otter population.

Numerous SSSIs, the UK's main national nature conservation designation, have also been designated throughout the Shetland Islands. Non-statutory sites include several sites owned or managed by the Royal Society for the Protection of Birds (RSPB) and the Scottish Wildlife Trust (RSPB, 2025; Scottish Wildlife Trust, 2025).

Three Ramsar sites, Mykines, Nolsoy and Skuvoy, all designated as important bird areas and 19 IBAs are also designated along the coast of the Faroe Islands (Ramsar, 2025; BirdLife International, 2025).

The southern west coast of Norway supports several sites of conservation importance, including 12 Ramsar sites and 10 IBAs designated for key wintering and breeding habitats for seabirds and waterbirds, as well as numerous MPAs and Nature Reserves along the coastline (BirdLife International, 2025; Ramsar, 2025; UNEP-WCMC, 2025).

Iceland supports several marine IBAs, MPAs, and 2 Ramsar sites, Andakill and Grunnaf Jordur, both located on the west coast of Iceland (BirdLife International, 2025; Ramsar, 2025; UNEP-WCMC, 2025).

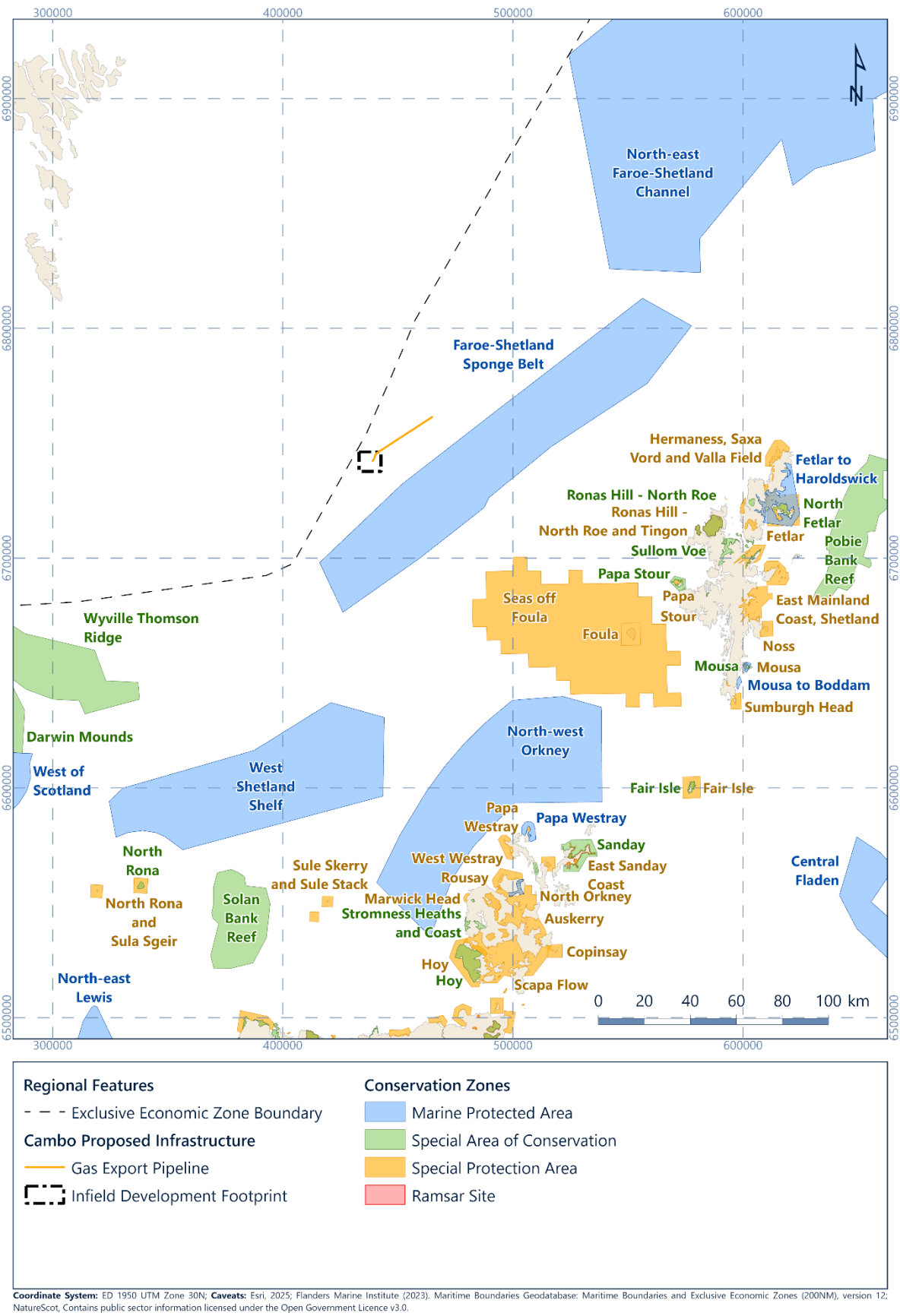
5.6.2 Offshore Conservation Areas

The Cambo FPSO is located approximately 16 km north of the Faroe-Shetland Sponge Belt NCMPA. This NCMPA has been designated for its deep-sea sponge aggregations, offshore subtidal sands and gravels, continental slope, ocean quahog aggregations, and other geological features (JNCC, 2022).

Deep-sea sponge aggregations are strongly influenced by the wide depth range from the upper continental slope to the depths of the channel and associated environmental conditions. A dynamic mixing zone where warmer Atlantic waters flow over cooler Arctic waters is present, creating limits to species distribution. The continental slope plays an important role in funnelling ocean currents that bring valuable food and nutrients to the region. For example, at depths of 400 m to 600 m, the combination of seabed sediment and plentiful supply of nutrients create ideal conditions for the establishment of deep-sea sponges (DECC, 2016). However, these aggregations have been reported at depths up to 1,300 m (OSPAR, 2025b; Bett & Rice, 1992). The deep-sea sponge aggregations habitat is included in the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR, 2025a).

In October 2025, Scottish Ministers implemented fishery management measures within the NCMPA which prohibits the use of demersal mobile and static gear from being used within certain areas of the site. The aim of these measures is to ensure that protected areas are managed to meet conservation objectives.

The Cambo FPSO is also located approximately 69 km northwest of the Seas off Foula SPA. The Seas off Foula SPA covers the waters around and to the northwest of the island of Foula. This island hosts more than 190,000 breeding seabirds, including one of the largest aggregations of great skuas in the UK, which are already protected on land and in the waters immediately surrounding the island by the overlapping Foula SPA. The Seas off Foula SPA complements the Foula SPA and ensures that the adjacent marine foraging area, which is an important feeding ground for great skuas, fulmars, gulls and auks, is equally protected (JNCC, 2025).



Coordinate System: ED 1950 UTM Zone 30N; **Caveats:** Esri, 2025; Flanders Marine Institute (2023). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 12; NatureScot, Contains public sector information licensed under the Open Government Licence v3.0.

Figure 5.18: Conservation areas

5.6.3 Sensitive Habitats

The Scottish PMF 'offshore subtidal sands and gravels' is widely distributed in UK waters (Tyler-Walters et al., 2016) and its presence in the proposed Cambo field development was supported by the PSD and photographic data acquired during the 2025 survey undertaken (Fugro, 2025a; 2025d). The habitat is listed as a habitat of principal importance on the Scottish Biodiversity List (NatureScot, 2025).

5.7 Other Users of the Sea

5.7.1 Commercial Fisheries

The Faroe-Shetland Channel, to the West of the Shetland Islands, supports a deepwater fishery for species such as blue ling, roundnose grenadier, orange roughy, black-scabbard fish and several deepwater sharks (Barreto et al., 2017). The deepwater fishery has little economic significance to the UK fishing industry as a whole (Barreto et al., 2017). The consensus of the International Council for the Exploration of the Seas (ICES) is that many of the deepwater fish stocks have declined and are now outside biological limits. Some species declines have been halted, but there is presently no sign of recovery (Barreto et al., 2017).

Fishing effort on the continental shelf to the north and northwest of Shetland is relatively high, with the fishing industry an important contributor to the economies of the Shetland and Orkney Islands. The mixed demersal fishery operates year-round and across the entire shelf area and to the northwest of the Shetland Islands. Herring fisheries operate in more inshore areas, whilst other pelagic fisheries are very seasonal and restricted to areas of the continental shelf break and beyond. Shellfish fisheries also operate in more inshore areas.

For the purposes of reporting fisheries statistics, the northeast Atlantic is divided into statistical rectangles by the ICES. The proposed Cambo field development lies within ICES rectangle 50E5 and 50E6 (Figure 5.19). Data is currently unavailable for ICES rectangle 50E5 (Marine Directorate, 2025c). It should be noted that recent landings data is currently only made publicly available if over five vessels were active in a particular ICES area. This means that the data presented here may be an underestimation of the actual overall fishing effort, tonnes of fish landed and/or sales value in this area (Marine Directorate, 2025c). In order to gain understanding of the overall fishing effort within the wider area of the proposed Cambo field development, analysis of commercial fishing has been conducted using ICES rectangle 51E6, 50E6, 49E5 and 49E6, the rectangles surrounding the proposed field development area for which statistics were available, allowing for a more reasonable comparison. Information on ICES rectangle 51E5 were unavailable or disclosive, due to the reason previously stated. Landings and fishing effort statistics for ICES rectangle 50E6 and the surrounding ICES rectangles 49E5, 49E6 and 51E6 are summarised in Figure 5.20.

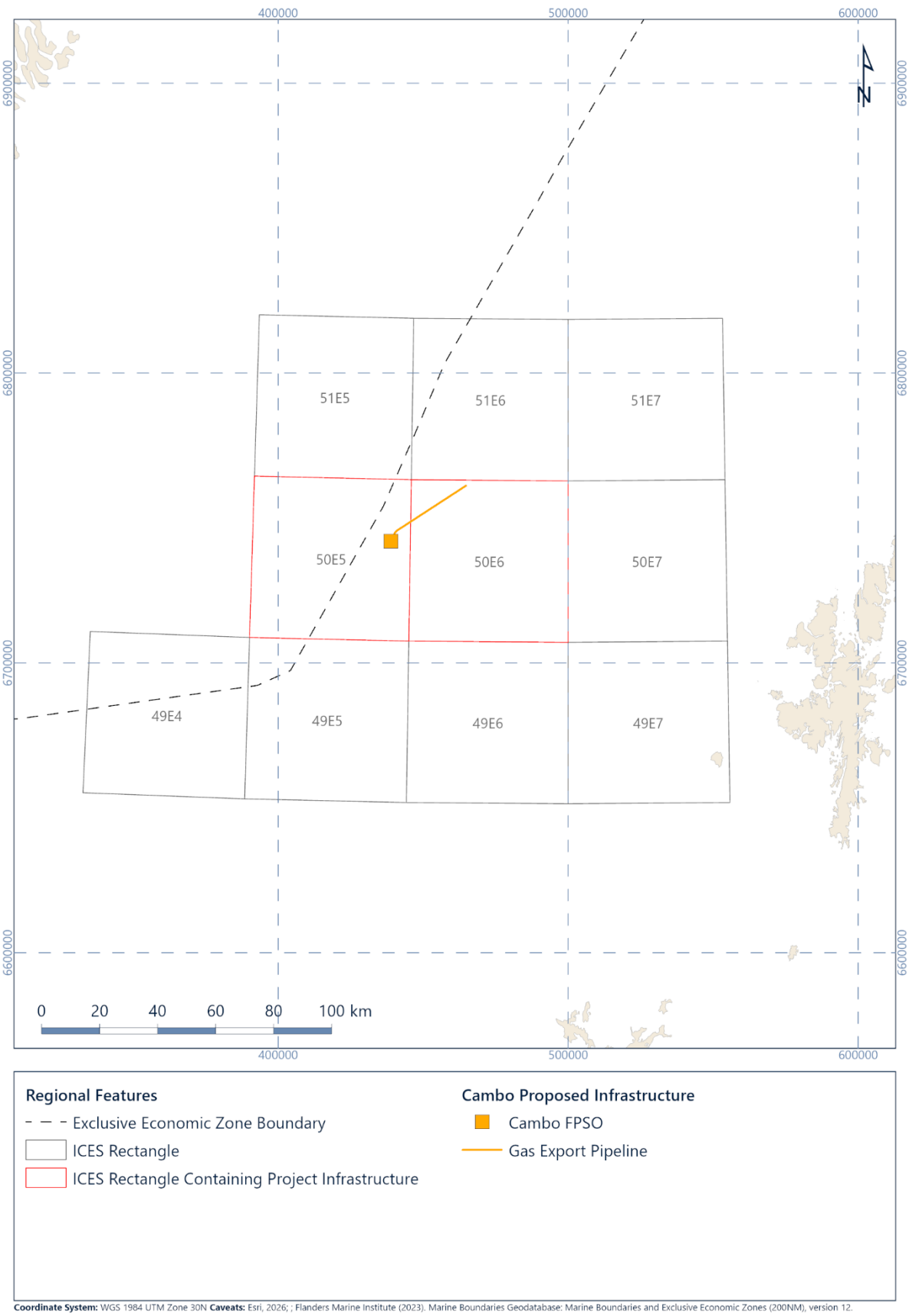


Figure 5.19: ICES rectangles overlapping with proposed Cambo field development

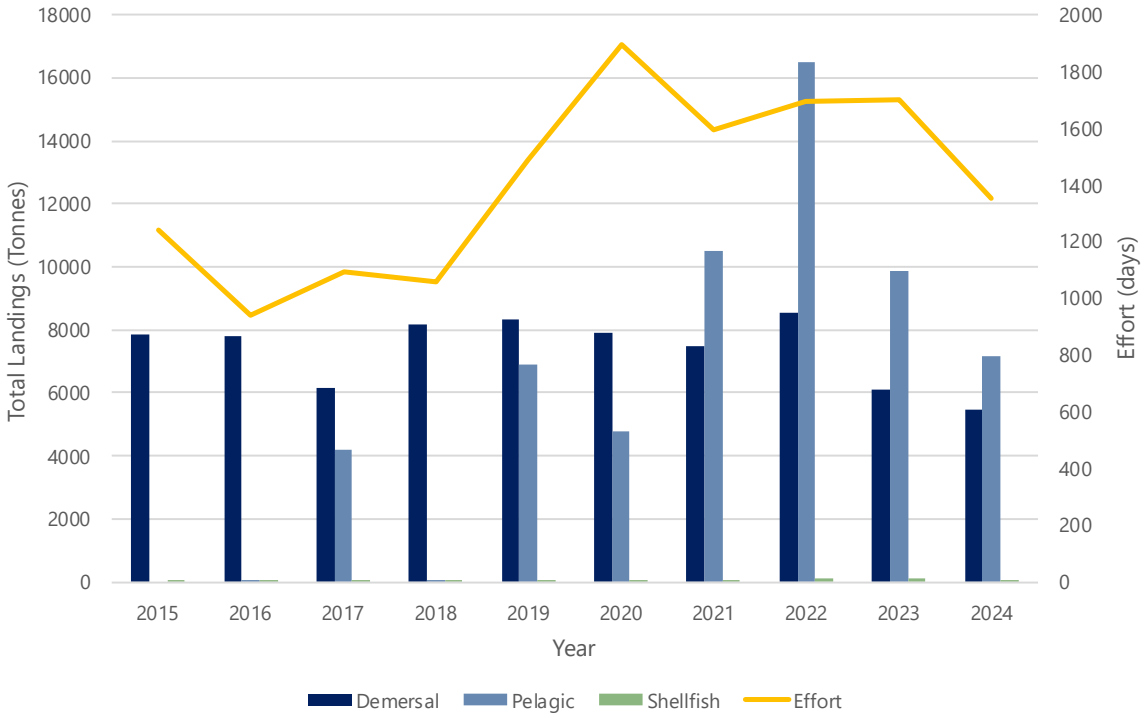


Figure 5.20: Total annual landings and effort from ICES rectangles 50E6, 51E6, 49E5 and 49E6 for the period 2015 – 2024 (Marine Directorate, 2025c).

Figure 5.21 shows fishing intensity by vessel type around the Cambo field development area for the period 2018 – 2021. Vessels operating in the area are mostly pelagic trawls and seines, fishing on average less than 10 hours per year (EMODnet, 2025). Fishing activity around the Cambo field development is considered to be very low compared to activity registered in the wider region, with fishing intensity being highest at the edge of the continental shelf and further inshore. Fishing restrictions which prohibit bottom trawling at depths greater than 800 m are currently place in the area of the Cambo field development.

A vessel traffic survey (VTS) using Automatic Identification System (AIS) data obtained within 10 nm of the Cambo FPSO location was carried out in 2025 and concluded that fishing vessels were typically recorded on passage through the area (Anatec, 2025). This agrees broadly with previous studies from the wider region. More specifically, a Cambo fishing intensity study undertaken in 2019 (Xodus, 2019), recorded the presence of fishing vessels, but in shallower waters (from ~183 m to 313 m water depth) compared to the area of proposals. The study reported that the main type of fishing activity around this shallower area was demersal fishing, with long liners (34.5 %) and gill netters (22.5 %) being the most used vessel type.

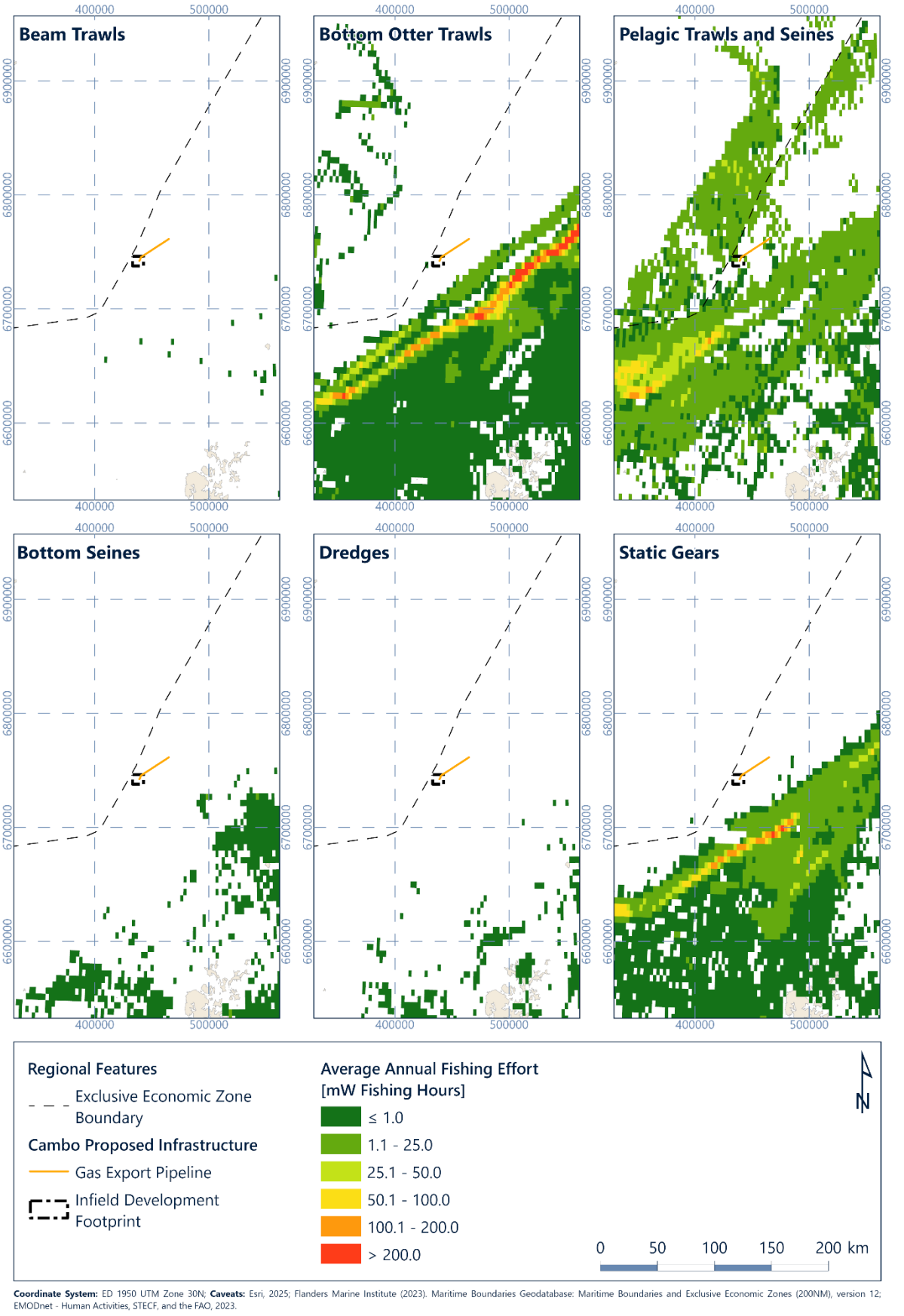


Figure 5.21: Fishing intensity in the vicinity of the Cambo field development

Demersal species have been consistently landed in the area between 2025 and 2024 (Marine Directorate, 2025c). The pelagic fishery has seen an increase in landings since 2017 over the same period, peaking in 2022 (Marine Directorate, 2025c). Shellfish species are landed in very small numbers across the area, although catches have increased slightly in recent years (Marine Directorate, 2025c).

Fishing effort between 2015 and 2024 has been generally consistent until 2018, when a sharp increase in effort has been reported in the area (Marine Directorate, 2025c). Following this increase, effort has remained largely stable for the consequent years.

Under the Common Fisheries Policy (Amendments etc.) (EU Exit) Regulations 2019, bottom trawling in waters deeper than 800 m is prohibited in international waters of the Northeast Atlantic. Therefore, there will be no bottom trawling fishing activity within the area of the proposed Cambo field development.

ICES catch data (ICES, 2025) from 2013-2023 for ICES division 27.4.a and 27.5.b.1.b were interrogated to further understand the fishing activity and species caught in the wider area of the Cambo field development for landings in other European Countries. The data across all years shows that the species with the highest reported landings (tonnes per live weight (TLW), in this instance landings of over 10,000 tonnes were used) are Atlantic herring and Atlantic mackerel in division 27.4.a, primarily landed in Norway, and blue whiting in 27.5.b.1.b landed mainly in Iceland. The highest landings for Atlantic herring were between 127,492 TLW and 94,891 TLW across 2013-2023 in ICES division 27.4a., and for Atlantic mackerel were between 195,054 TLW and 123,808 TLW across the same period and area. In ICES division 27.5.b.1.b, highest landings of blue whiting ranged between 282,424 TLW and 80,877 TLW for the period 2013-2023. Figure 5.22, Figure 5.23, and Figure 5.24 show the fish species with the highest landings across 2013 and 2023 per country.

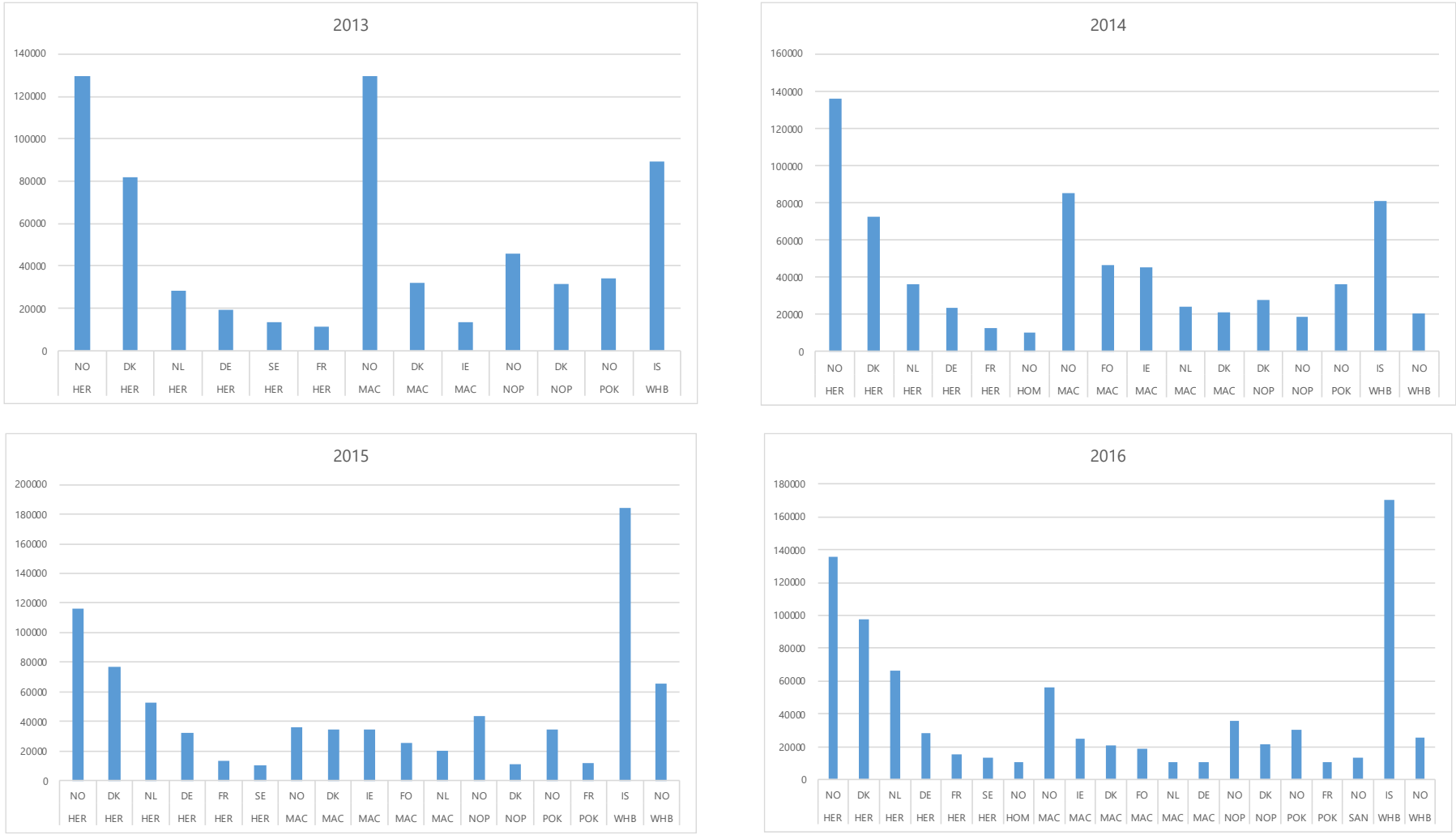


Figure 5.22: Fish landings in tonnes per species per country excluding UK for ICES Areas 27.5.b.1.b and 27.4.a across 2013-2016 (ICES, 2025)

HER: Herring	HOM: Horse mackerel	MAC: Mackerel	NOP: Norway Pout	POK: Saithe	SAN: Sandeel	WHB: Blue whiting
DE: Germany	DK: Denmark	FO: Faroe Islands	FR: France	IE: Ireland	IS: Iceland	NL: Netherlands	NO: Norway	SE: Sweden

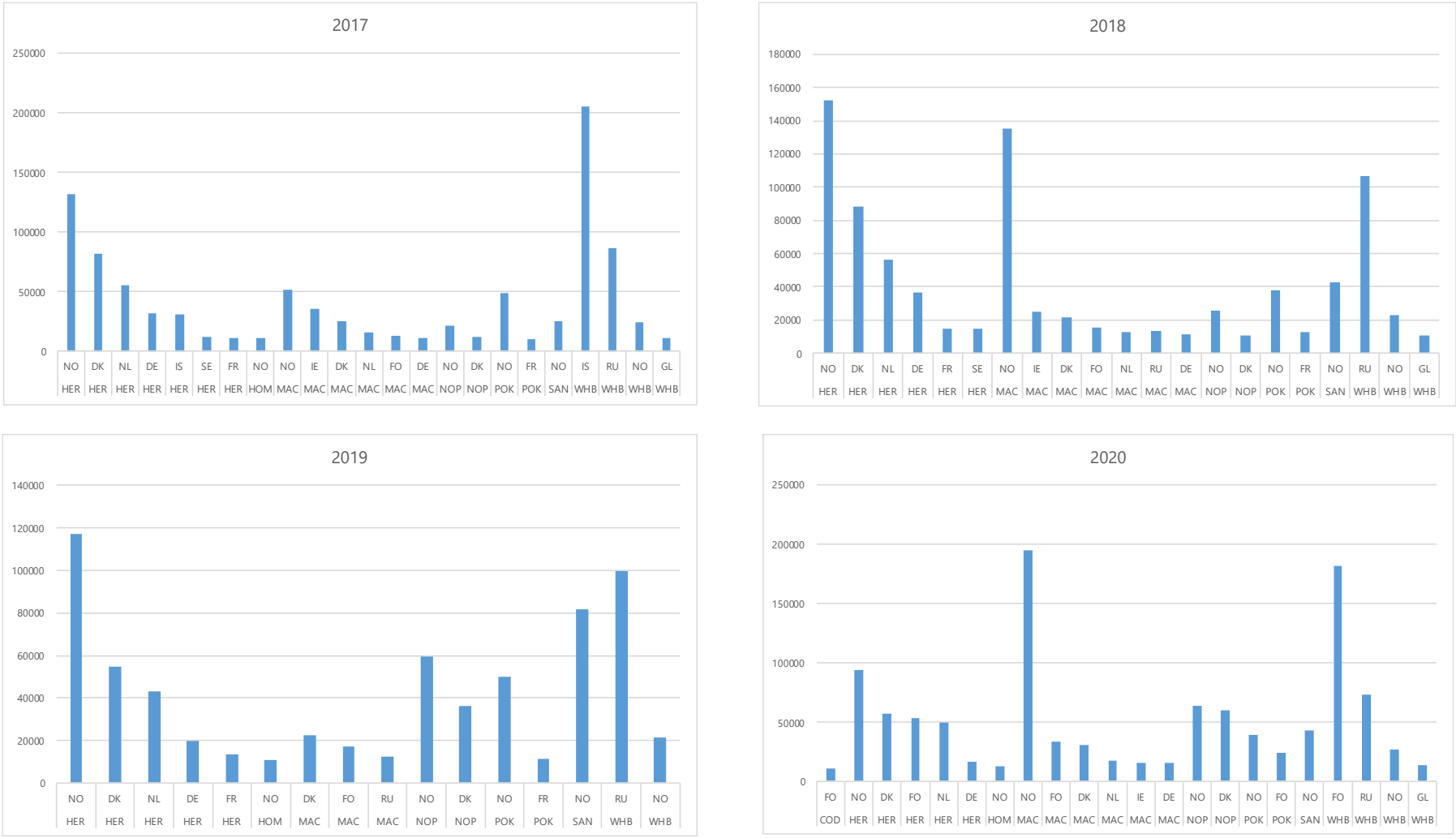


Figure 5.23: Fish landings in tonnes per species per country excluding UK for ICES Areas 27.5.b.1.b and 27.4.a across 2017-2020 (ICES, 2025)

COD: Cod	HER: Herring	HOM: Horse mackerel	MAC: Mackerel	NOP: Norway Pout	POK: Saithe	SAN: Sandeel	WHB: Blue whiting
DE: Germany	DK: Denmark	FO: Faroe Islands	FR: France	GL: Greenland	IE: Ireland	IS: Iceland	NL: Netherlands	NO: Norway	RU: Russia	SE: Sweden

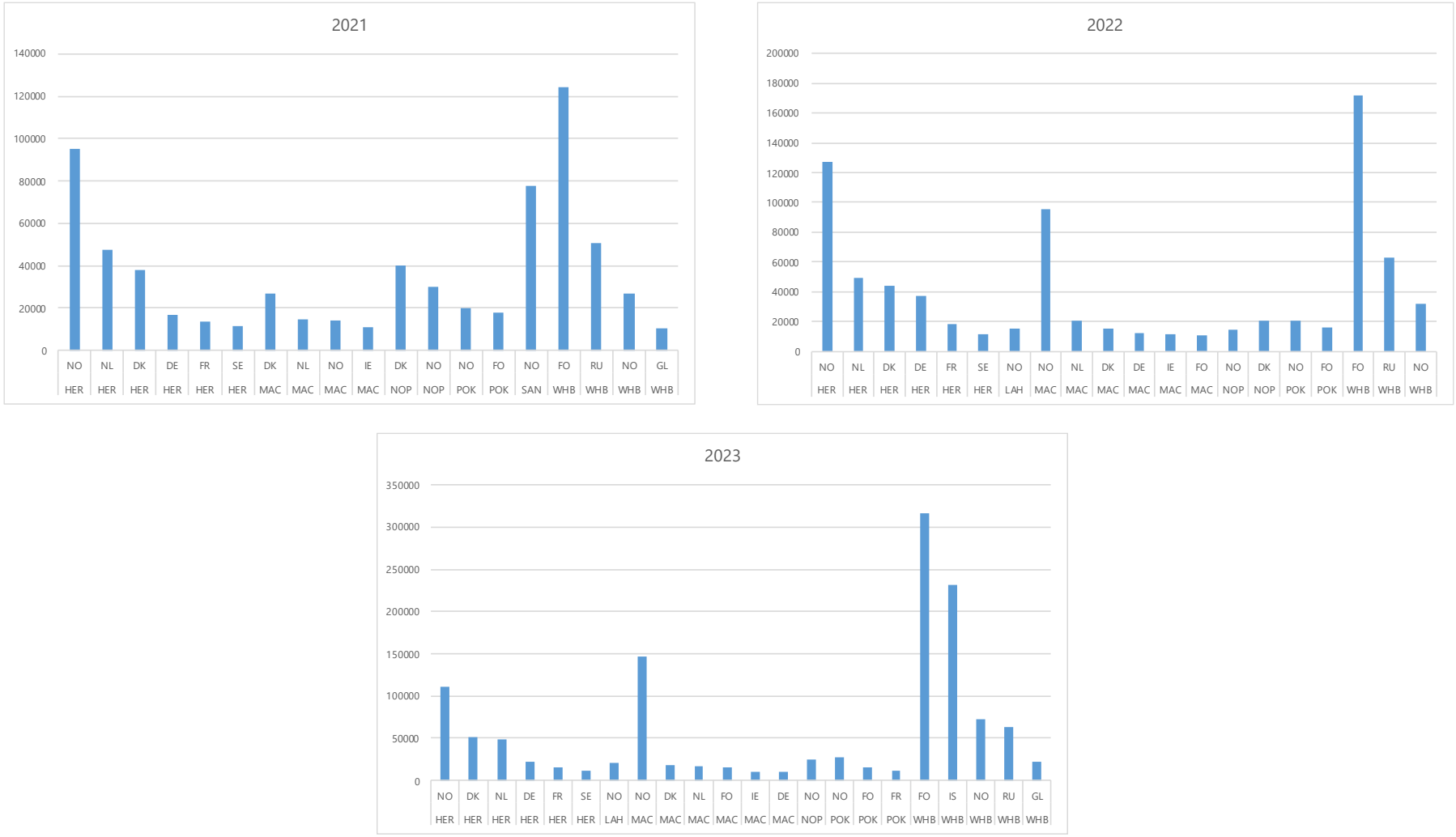


Figure 5.24: Fish landings in tonnes per species per country excluding UK for ICES Areas 27.5.b.1.b and 27.4.a across 2021-2023 (ICES, 2025)

HER: Herring	LAH: North European kelp	MAC: Mackerel	NOP: Norway Pout	POK: Saithe	SAN: Sandeel	WHB: Blue whiting			
DE: Germany	DK: Denmark	FO: Faroe Islands	FR: France	GL: Greenland	IE: Ireland	IS: Iceland	NL: Netherlands	NO: Norway	RU: Russia	SE: Sweden

5.7.1.1 Effort

In 2024, fishing effort in Scotland was a total of 92,332 days, whilst total effort registered within ICES rectangles 50E6, 51E6, 49E5, and 49E6 amounted to 1,351 days (Marine Directorate, 2025c).

A summary of annual fishing effort is presented in Table 5.10. Between 2015 and 2024, the highest overall annual fishing effort by UK vessels was 1,143 days in 2020 recorded for ICES rectangle 49E6 (Marine Directorate, 2025c). The lowest annual fishing effort in the area was 36 days registered in 2015 for ICES rectangle 50E6, which directly overlaps with the Cambo field development area (Marine Directorate, 2025c). Annual fishing effort data for ICES rectangle 51E6 is currently disclosive or not available for all years considered in this analysis.

Table 5.10: Annual fishing effort for ICES rectangles 50E6, 51E6, 49E5 and 49E6 for the period 2015 – 2024 (Marine Directorate, 2025c)

Year	50E6		51E6		49E5		49E6	
	Total [days]	% of Scottish Total	Total [days]	% of Scottish total	Total [days]	% of Scottish total	Total [days]	% of Scottish total
2015	36	0.029			267	0.214	935	0.749
2016	69	0.053			265	0.201	606	0.460
2017	79	0.063			364	0.289	650	0.516
2018	56	0.045			334	0.267	667	0.534
2019	94	0.075			376	0.298	1,020	0.808
2020	100	0.096	-		650	0.626	1,143	1.101
2021	57	0.054			564	0.534	971	0.920
2022	182	0.193			547	0.579	967	1.024
2023	150	0.158	-		494	0.518	1,058	1.109
2024	135	0146			521	0.564	696	0.753

Notes
'-' represent disclosive data; blank values represent no data.

Monthly fishing effort is detailed in Table 5.11. As monthly effort data for ICES rectangle 51E6 were not available for most years, with the exception of disclosive data reported for April 2020 and February and November 2023, this rectangle has not been included in Table 5.11.

Fishing effort varies greatly across the considered ICES rectangles, likely due to 50E6 mostly encompassing an area off the continental shelf whilst 49E5 and 49E6 are positioned at the edge of the shelf where fishing activity is highest. Generally, the majority of fishing in these rectangles takes place between November and January, with a peak in effort in December (Marine Directorate, 2025c). Hooks and lines are the most used gear type in the area, with the highest recorded effort value being 652 days in 49E6 in 2023. Trawls are also commonly used, accounting for 539 days of fishing effort in 2021 for 49E6 at their highest value. The use of

other gear types, such us gill nets, seine nets, and traps, is also recorded in the area but effort data for these gear types is currently classified as disclosive (Marine Directorate, 2025c).

Table 5.11: Monthly fishing effort for ICES rectangles 50E6, 49E5, and 49E6 for the period 2015 – 2024 (Marine Directorate, 2025c)

ICES Rectangles	Year	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
50E6	2015		-	-	-	7	-	-	-	-	-	-	-
	2016	10	-		-	28	-	-	-	-	-		-
	2017		-	-	-	-	-	-		-		14	15
	2018	-	7	14	-	-	-	-		-	-	-	-
	2019	13	-	-	-	-	-		-	25	31	-	-
	2020	18	-	-	-	-	-	-	22	17	-	10	5
	2021	-	8	-	-	-	-	-	5	-	-	-	14
	2022	5	3	-	5	17	16	7	-	23	49	-	43
	2023	-		10	-	-	15	-	13	10	-	42	26
	2024	12	4	5	-	4	20	22	8		10	14	36
49E5	2015	21	-	9	16	27	43	26	19	13	18	36	40
	2016	17	8	25	20	46	45	19	-	16	29	13	25
	2017	48	30	36	27	20	21	11	15	8	20	33	97
	2018	59	39	35	28	23	21	14	11	14	9	38	42
	2019	54	20	17	21	23	24	18	10	37	61	31	59
	2020	86	81	41	51	27	34	37	52	30	68	48	95
	2021	71	46	60	37	27	26	35	39	30	43	51	99
	2022	49	70	88	54	55	42	32	11	48	32	26	40
	2023	21	95	96	39	44	38	48	14	17	12	53	17
	2024	110	69	45	31	52	62	36	30	8	25	39	14
49E6	2015	116	30	79	104	81	68	84	58	68	81	64	111
	2016	124	80	83	33	32	36	7	10	25	48	62	76
	2017	120	53	55	59	34	9	9	31	41	41	64	134
	2018	79	69	101	68	61	16	15	11	50	28	56	112
	2019	184	101	119	72	24	31	42	20	109	74	101	144
	2020	115	109	50	87	78	54	50	89	117	112	96	186
	2021	162	107	82	71	49	31	33	81	55	88	107	106
	2022	107	115	130	80	22	16	32	22	56	79	156	153
	2023	196	99	100	56	22	61	27	40	77	94	131	155
	2024	62	50	71	33	24	53	53	31	52	103	94	70

ICES Rectangles	Year	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
< 25 days	25 – 50 days	50 – 100 days		100 – 250 days		250 – 500 days	500 – 750 days		>750 days		DD	No data	
Notes DD = Disclosive Data													

5.7.1.2 Landings

In 2024, UK vessels landed approximately 594,481 tonnes of fish and shellfish (Marine Directorate, 2025c). Approximately 12,709 tonnes of fish were landed in ICES rectangles 50E6, 51E6, 49E5, and 49E6, accounting for 2 % of the total landings made by vessel in Scotland for 2024 (Marine Directorate, 2025c). Landings recorded in 50E6, which directly overlaps with the Cambo field development, only accounted for 0.05 % of the Scottish total for 2024.

Fishing in ICES rectangles 50E6, 51E6, 49E5, and 49E6 occurs year-round and varies greatly across the considered rectangles, as shown in Table 5.12. Monthly landings data for ICES rectangle 51E6 were not available for most years, with the exception of disclosive data reported in January 2019, April 2020, February and November 2023 (Marine Directorate, 2025c). As such, this rectangle has not been included in Table 5.12.

As already highlighted in Section 5.7.1.1, landing data for ICES rectangles encompassing a large area off the continental shelf (i.e. 50E6 and 51E6) reported much lower fish landing values for the period 2015 – 2024 in comparison to 49E5 and 49E6 situated at the edge of the shelf were fishing activity is higher. Landings are also highly variable on a month-by-month basis between each considered rectangle, with highest fish landings occurring between March and June in 50E6 whilst January registered the highest landings for both 49E5 and 49E6 (Marine Directorate, 2025c).

Table 5.12: Monthly fish landings (tonnes) by UK vessels between 2015 and 2024 in ICES rectangle 50E6 (Marine Directorate, 2025c)

Year	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
50E6 – Fish Landings [tonnes]												
2015		-		-	102	-	-	41	-	-	-	-
2016	75	-		61	-	86	-	-	-	-	-	-
2017		-	-	-	65	53	-	-	-	-	-	59
2018	-	31	30	84	111	-	-	-	23	89	-	21
2019	31	-	57	-	107	10	-	-	69	37	33	-
2020	-	-	169	-	14	-	17	75	34	266	13	11
2021	-	18	-	-	-	-	28	42	21	-		10
2022	-	19	-	77	71	112	22	92	79	85	-	83
2023	-	-	-	-	33	62	64	36	39	-	56	39

Year	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
2024	16	10	11	10	12	58	49	47	-	19	13	41
49E5 – Fish Landings [tonnes]												
2015	299	-	202	154	452	266	226	268	142	103	191	290
2016	277	92	202	248	358	309	154	69	259	466	198	376
2017	1,119	419	272	138	137	121	67	130	62	142	325	547
2018	391	288	331	261	422	287	171	117	161	134	393	333
2019	1,123	199	260	407	213	267	300	144	252	685	461	347
2020	3,530	1,254	336	267	312	291	239	349	224	343	309	372
2021	1,002	207	299	267	350	316	502	511	367	246	287	205
2022	537	447	452	456	556	452	451	215	762	170	113	166
2023	40	270	411	217	354	466	470	153	154	121	249	208
2024	7,308	263	116	219	314	367	415	252	137	198	221	144
49E6 – Fish Landings [tonnes]												
2015	565	139	485	745	785	256	398	223	283	213	319	480
2016	760	593	530	407	211	429	150	59	104	190	541	455
2017	3,901	535	426	309	86	112	62	191	191	135	253	401
2018	552	384	502	609	367	197	74	144	569	193	461	408
2019	6,672	373	496	393	304	167	223	115	208	571	378	333
2020	642	247	364	450	350	222	189	303	232	383	335	563
2021	10,123	355	406	401	205	166	89	504	296	300	247	244
2022	16,323	502	503	584	162	46	82	111	229	275	347	530
2023	10,326	274	338	145	68	151	229	140	188	204	255	273
2024	236	173	265	281	182	240	148	111	163	337	164	138

Notes
'-' represent disclosive data; blank values represent no data.

Annual total values of landings for ICES rectangles 50E6, 49E5, and 49E6 are presented in Table 5.13, whilst values for 51E6 were not available or disclosive for the entire period considered and have thus not been included. Highest total landing value between 2015 and 2024 reported is approximately £129 million from 49E6, whilst total value of fish caught in 50E6, which directly overlaps with the Cambo field development, was much lower at £7,030,185 over the same time period (Marine Directorate, 2025c).

Table 5.13: Landing values (£) for fish caught in ICES rectangles 50E6, 49E5, and 49E6 (Marine Directorate, 2025c)

ICES Rectangle	Year	Demersal [£]	Pelagic [£]	Shellfish [£]	Total
50E6	2015	610,466		3,366	613,832
	2016	838,740		774	839,514
	2017	601,976	592	1,847	604,414
	2018	829,495	455	1,085	831,036
	2019	730,089	18	2,246	732,353
	2020	576,056	111	2,140	578,307
	2021	287,187		3,968	291,155
	2022	1,368,213		4,264	1,372,477
	2023	604,173		7,910	6,120,83
	2024	553,317		1697	555,014
Total		6,999,712	1,176	29,298	7,030,185
49E5	2015	4,519,000		9,937	4,528,938
	2016	5,520,601	679	8,153	5,529,432
	2017	5,005,805	719,912	18,443	5,744,160
	2018	5,451,980	86	50,850	5,502,917
	2019	5,840,223	942,124	140,188	6,922,536
	2020	3,381,365	4,765,337	106,061	8,252,762
	2021	4,632,391	819,747	92,705	5,544,843
	2022	5,464,985	555,571	196,361	6,216,917
	2023	4,997,076	42	115,319	5,112,437
	2024	5,497,525	30,337,101	89,694	35,924,319
Total		50,310,952	38,140,598	827,713	89,279,262
49E6	2015	10,720,159		30,189	10,750,348
	2016	9,769,186	435	35,236	9,804,856
	2017	7,000,994	2,945,165	61,344	10,007,504
	2018	8,466,001	855	58,249	8,525,105
	2019	8,463,868	7,411,588	129,194	16,004,651
	2020	6,275,407	296,993	131,129	6,703,529
	2021	6,349,875	9,357,465	162,096	15,869,437
	2022	7,706,242	20,472,760	258,964	28,437,966
	2023	5,498,652	12,562,703	203,687	18,265,041
	2024	5,159,572	4,749	108,404	5,272,726
Total		75,409,958	53,052,713	1,178,492	129,641,163

5.7.1.3 Demersal Fisheries

Demersal fisheries target species which live on or near the seabed and generally feed on bottom-living organisms and other fish. Although these fisheries may be directed towards a particular species or species group, demersal fish are often caught together and comprise a mixed fishery. The main demersal species caught within ICES rectangles 50E6, 51E6, 49E5 and 49E6 between 2015 and 2024 were saithe, hake, monks, and blue ling (Marine Directorate, 2025c).

Average demersal landings and sales value typically decreases with distance from the edge of the continental shelf across the wider area (Marine Directorate, 2025c). Landings and values of demersal fish species caught from ICES rectangles 50E5 and 50E6, where the Cambo field development is located, are generally much lower than the surrounding ICES rectangles, with no pelagic fish species landed in ICES rectangle 50E5 (Figure 5.25). Larger quantities of demersal fish are mostly landed from ICES rectangles to the south (Marine Directorate, 2025c).

Total fishing effort by UK vessels of more than 10 m in length using demersal active gear between 2018 and 2022 within rectangles 50E5 and 50E6 was 154 days (NMPi, 2025). In the wider area, fishing effort for demersal active gear is greater to the southeast of the Cambo field development.

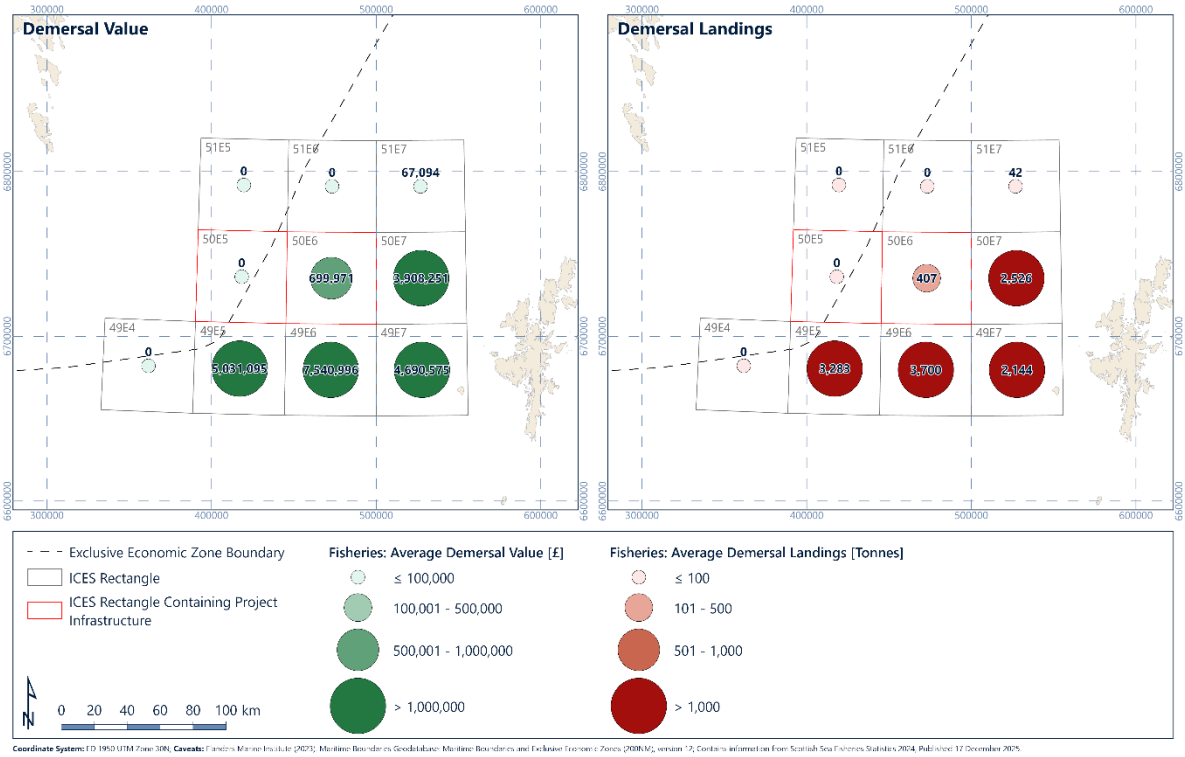


Figure 5.25: Average demersal value (£) and landings (tonnes) in the vicinity of the Cambo field development between 2015 and 2024

5.7.1.4 Pelagic Fisheries

Pelagic fisheries target species which live in the water column. Pelagic fisheries in the North Sea are generally more active in deeper waters, predominantly targeting herring and mackerel. The main pelagic species caught within ICES rectangles 50E6, 51E6, 49E5 and 49E6 between 2015 and 2024 were mackerel and herring (Marine Directorate, 2025c).

Average pelagic landings and sales value typically decreased with distance from shore across the wider area (Marine Directorate, 2025c). Pelagic fish species are not landed in ICES rectangle 50E5 while landings and values of demersal species caught from ICES rectangles 50E6 are much lower than many of the surrounding ICES rectangles (Figure 5.26). Majority of landed of pelagic species in the area were reported to the southwest of the Cambo field development at the edge of the continental shelf (Marine Directorate, 2025c).

No fishing effort by UK vessels of more than 10 m in length using pelagic active gear between 2018 and 2022 was recorded in ICES rectangles 50E5 and 50E6 (NMPi, 2025). Higher fishing effort for pelagic active gear was recorded to the southwest, although effort for this gear type was still comparatively much lower than effort recorded for other gear types in the wider area (Marine Directorate, 2025c).

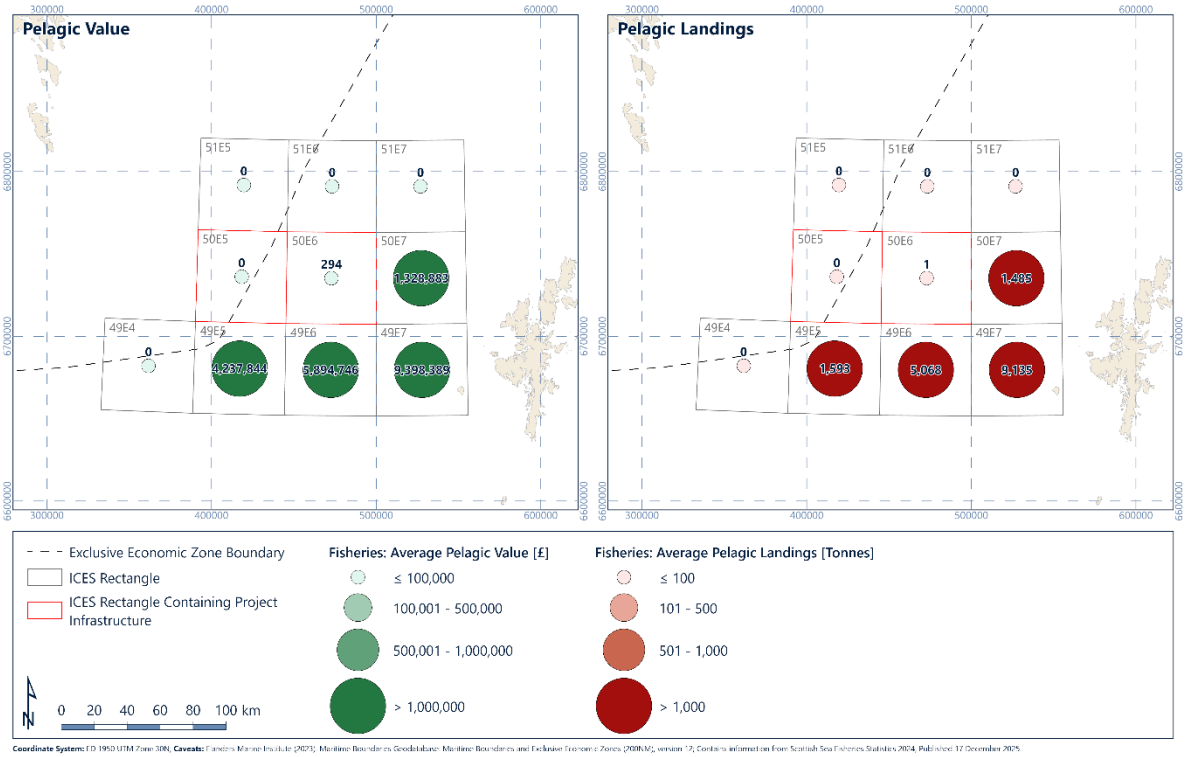


Figure 5.26: Average pelagic value (£) and landings (tonnes) in the vicinity of the Cambo field development between 2015 and 2024

5.7.1.5 Shellfish Fisheries

Shellfish fisheries can be broadly divided into offshore and onshore components. Static gears such as creels and pots are used in inshore areas to catch crabs and lobsters, while the offshore component targets *Nephrops* and scallops using trawls. The main shellfish species landed between 2015 and 2024 in ICES rectangles 50E6, 51E6, 49E5 and 49E6 was squid (Marine Directorate, 2025c).

Average shellfish landings are typically low across the wider area and decrease with distance from shore (Marine Directorate, 2025c). No shellfish species to very low quantities of landed shellfish were landed in ICES rectangles 50E5 and 50E6. In the wider area around the Cambo field development, shellfish landings and values are relatively low, with the highest numbers recorded to the southwest of the proposed field development (Figure 5.27; Marine Directorate, 2025c).

Fishing effort by UK vessels of more than 10 m in length using passive gear between 2018 and 2022 in ICES rectangle 50E6 was 287 days, whilst not effort for this gear type was recorded in 50E5 (NMPi, 2025). Passive gear is most used to the south and southwest of the Cambo field development (NMPi, 2025).

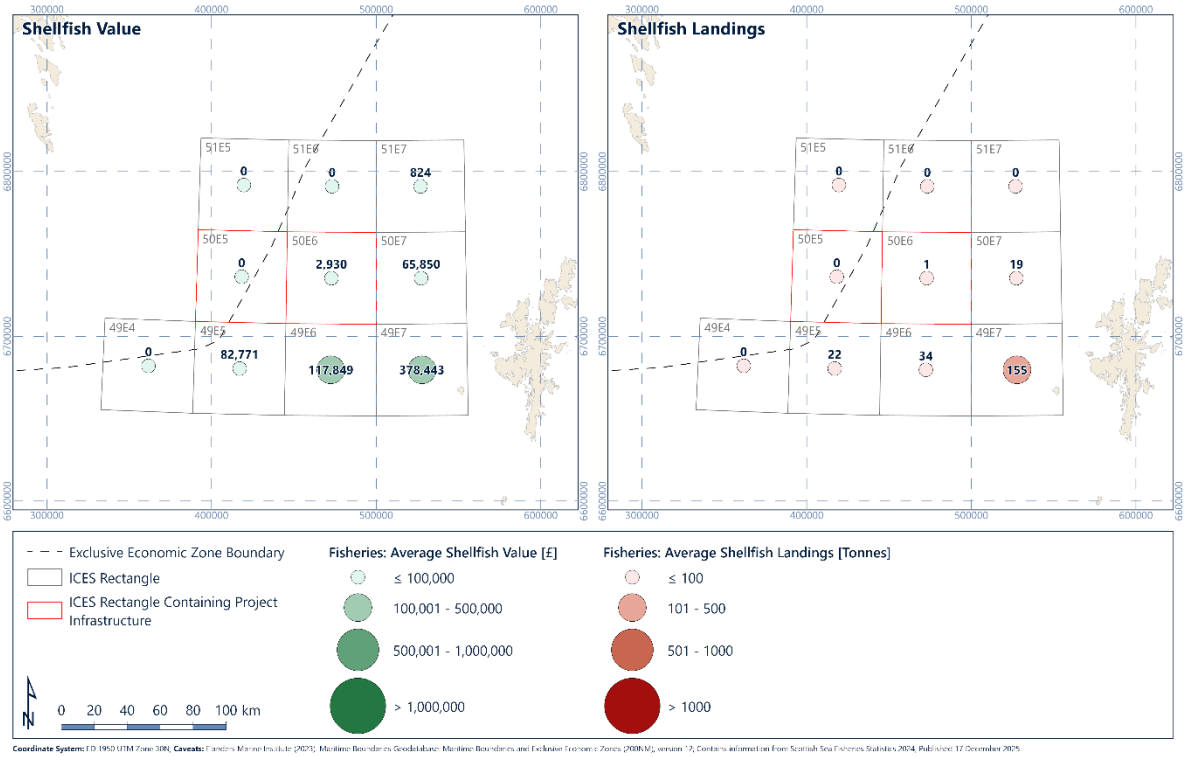


Figure 5.27: Average shellfish value (£) and landings (tonnes) in the vicinity of the Cambo field development between 2015 and 2024

5.7.2 Aquaculture

No aquaculture site is located in the immediate vicinity of the Cambo field development. The closest aquaculture site is approximately 141 km east of the Cambo FPSO on the Shetland Islands (NMPi, 2025).

Numerous fish farms are distributed across the Orkney and Shetland Islands (Figure 5.28). The many voes and inlets around the islands' coastlines are ideal for finfish cultivation, providing shelter and appropriate current conditions (Scotland's Aquaculture, 2025; Marine Directorate, 2025a). Aquaculture therefore contributes an important component to the local economy. While salmon is the main species cultivated in this area, aquaculture in the region has diversified into producing species such as cod and halibut in recent years (Scotland's Aquaculture, 2025; Scottish Government, 2024). In 2023, 33,414 tonnes of farmed Atlantic salmon were produced from Shetland and 17,265 tonnes of salmon were produced from Orkney (Scottish Government, 2024). Salmon cultivation begins in freshwater hatcheries, before the fish reach the smolt stage at around eight to twelve months, when they are transferred to seawater cages.

Shellfish are also cultivated in this region, with approximately 146 shellfish sites on Shetland in 2024 and 2 on Orkney (Marine Directorate, 2025a). Most of Shetland's shellfish farms are situated on the moderately exposed west coast of the mainland, the majority of which produce mussels (Scottish Government, 2025). In 2024, over 10,234 tonnes of mussels grown in Shetland, accounting for 87 % of Scottish mussel production (Scottish Government, 2025). Mussels are typically cultured on rafts or ropes and nets hung in the water column. A small amount of Pacific oysters are also cultivated on Shetland. Oysters are typically grown in netted bags fastened onto trestles, or on the seabed on racks (Scotland's Aquaculture, 2025). Shellfish farms on Orkney are mainly located around the mainland and they produce salmon, trout, halibut, and various shellfish species like crab, lobster, and scallops.

The Scottish Government has introduced a package of measures to ensure the continued protection and improvement of shellfish growing waters in Scotland. Numerous Shellfish Water Protected Areas have been established around the coasts of Shetland and Orkney, with each area having environmental objectives as part of the river basin management planning process. The closest Shellfish Waters Protected Area is a site called 'Ronas Voe Area' on the Shetland Islands located approximately 145 km from the Cambo FPSO (Marine Directorate, 2025a).

Aquaculture is also widespread in the Faroe Islands, with fish and fish products, including farmed salmon, making up nearly 95 % of total exports and 20 % of the gross national product (ICES, 2023). The majority of fish produced are Atlantic salmon, along with small amounts of trout, cod, haddock, and saithe. Seaweed is also grown (ICES, 2023).

Aquaculture is also of importance to the economy of Norway. Numerous finfish farms producing species such as Atlantic salmon, rainbow trout, Arctic char, Atlantic halibut and cod from seawater cages are present along the entire coastline. A smaller number of shellfish farms are also present, mainly producing blue mussels, with smaller amounts of great Atlantic scallop,

oysters, and lobsters (Norwegian Directorate of Fisheries, 2024). In Norway, kelp cultivation is a new priority in aquaculture, and 600 tonnes of sugar kelp (*Saccharina latissima)* and winged kelp (*Alaria esculenta*) were cultivated and harvested in 2023 (Norwegian Blue Forests Network, 2023).

5.7.3 Oil and Gas Infrastructure

The waters of the West of Shetland region are relatively undeveloped in terms of oil and gas infrastructure, in comparison with the neighbouring northern North Sea (Figure 5.29).

The Rosebank field is found approximately 23 km north of the Cambo FPSO and approximately 5 km away to the northwest of the end of the proposed pipeline connecting Cambo to Rosebank. The Loyal, Schiehallion and Foinaven fields are located around 41 km, 46 km, and 51 km, respectively, to the south of the Cambo FPSO, and are tied back via the West of Shetland Pipeline (WOSP) to the Clair platform, 72 km to the east of the Cambo FPSO (NSTA, 2025d). In turn, the Clair field produces via pipeline to the Sullom Voe Terminal in the Shetland Islands. The Tormore and Laggan fields are located around 48 km and 60 km east of the Cambo FPSO, respectively, and also produce back to the Sullom Voe Terminal by pipeline. The Edradour and Glenlivet fields also tie into this pipeline. Various oil fields in the development stage are also located in the wider area around the proposed Cambo field development location (NSTA, 2025d).

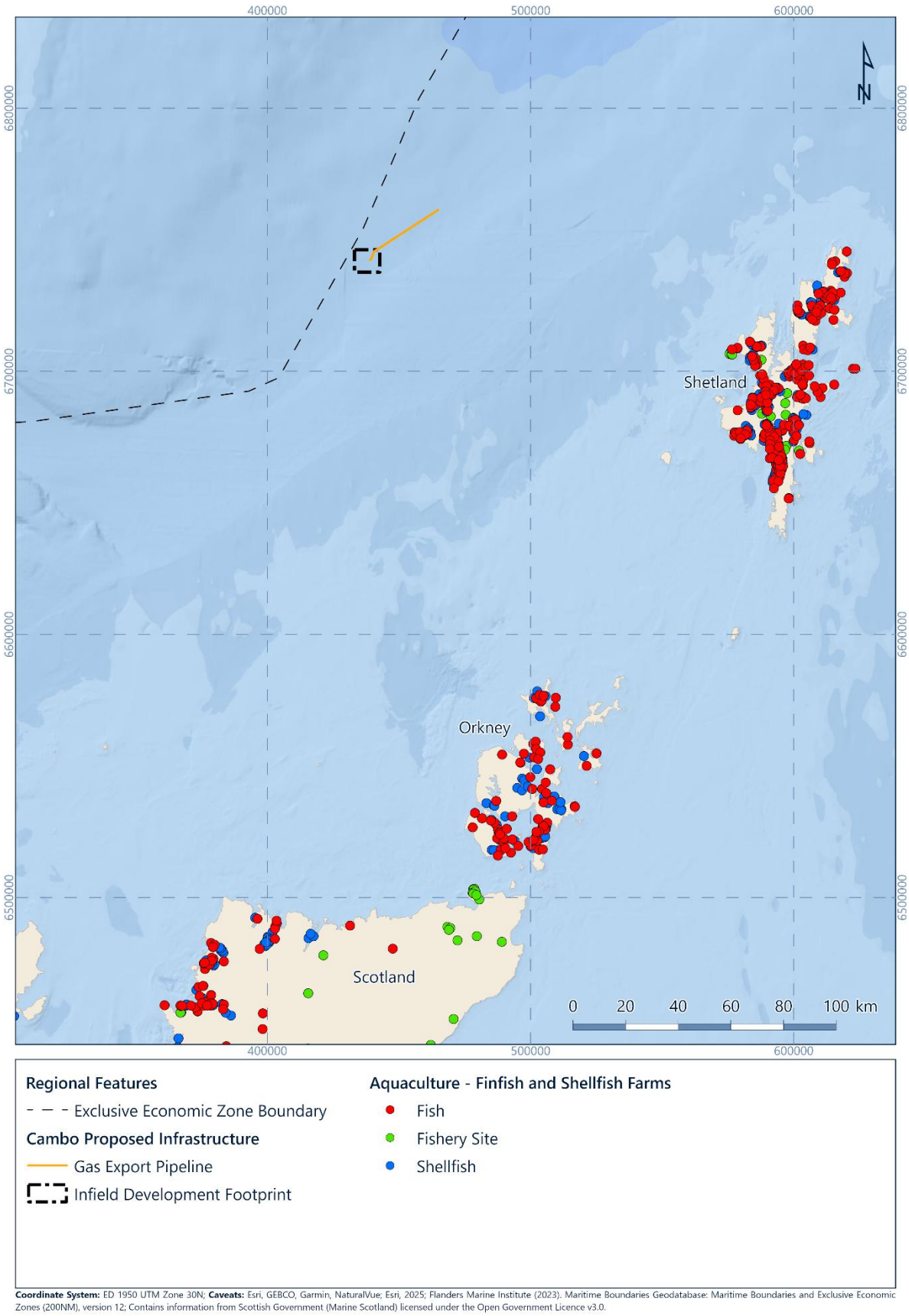
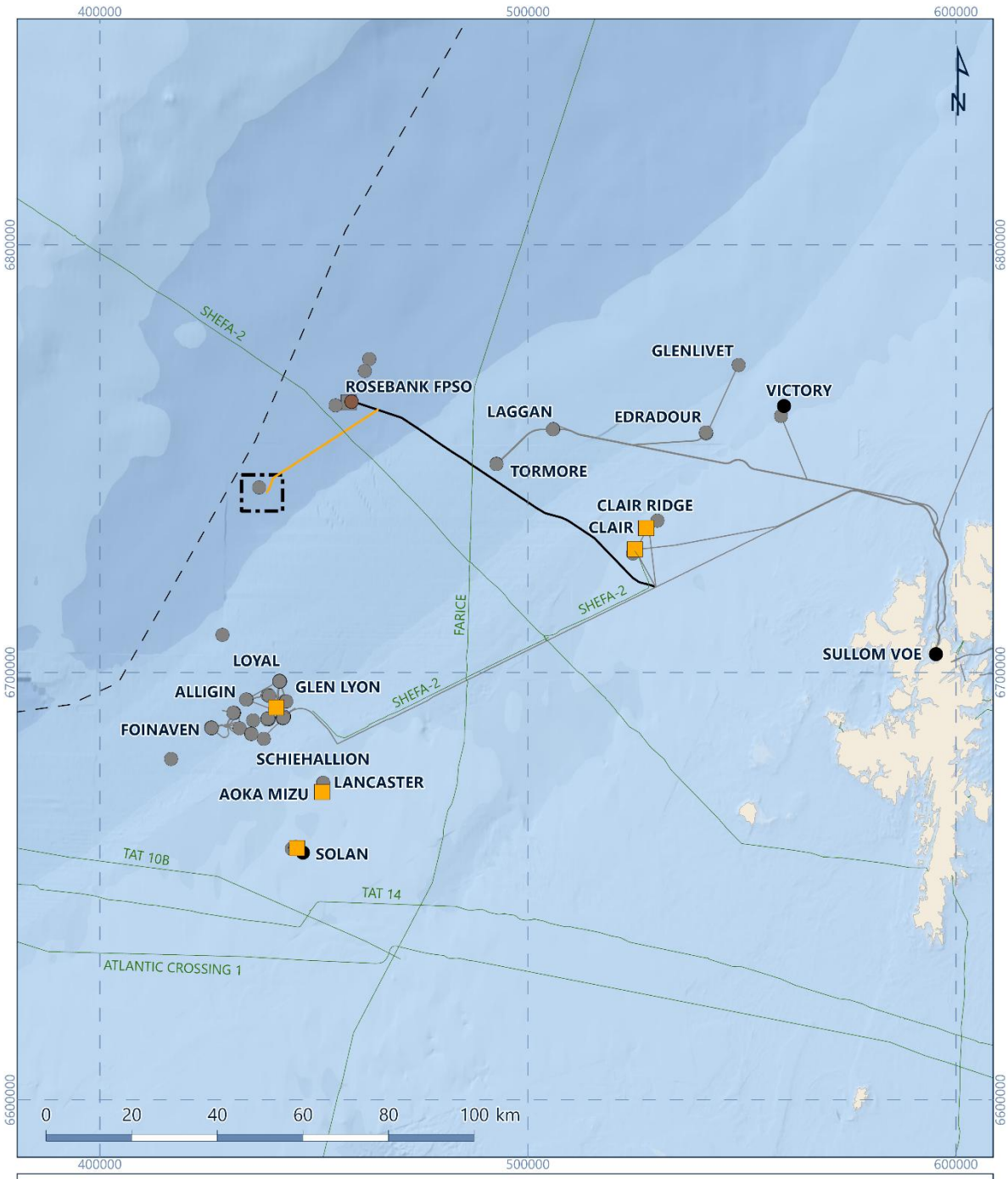


Figure 5.28: Aquaculture sites



Coordinate System: ED 1950 UTM Zone 30N; **Caveats:** GEBCO, Garmin, NaturalVue; Esri, 2025; Contains information provided by the North Sea Transition Authority and/or other third parties; Flanders Marine Institute (2023). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 12; Contains information from Scottish Government (Marine Scotland) licensed under the Open Government Licence v3.0; KIS-ORCA 2015 (Reproduced with permission of The Kingfisher Information Service, Seafish, on behalf of Subsea Cables UK).

Figure 5.29: Oil and gas and other infrastructure

5.7.4 Shipping

The Faroe-Shetland Channel experiences very low densities of shipping traffic (Hartley Anderson & University of Aberdeen, 2003). In particular, Blocks 204/10 is designated as an area of very low shipping density, while shipping density in Blocks 204/5, 205/1 and 205/2 was reported as negligible (NSTA, 2017).

The average annual shipping route density for all vessels in the Cambo field development area for the period 2019 to 2024 is reported to be between less than 10 and 100 routes per km² per year (Figure 5.31). Data on vessel density between 2017 and 2023, found that the annual average vessels density in the area is less than 0.5 hours per km² per month (EMODnet, 2025). Most of the shipping traffic in the Cambo field development area is composed of tankers and cargo ships (EMODnet, 2025).

A vessel traffic study was commissioned in 2025 within the Cambo FPSO location (Block 204/10). This study identified 19 shipping routes which would pass within 18.5 km (10 nm) of the Cambo field development location. It was estimated that these routes were used by a total of 240 vessels each year, corresponding to an average of 4 to 5 vessels per week. Most of this traffic was made up of cargo vessels, with the predominant size range being 5,000 to 15,000 dead weight tonnes. The Rotterdam to Fuglafjordur route, which is used by an estimated 22 vessels per year (Anatec, 2025), crosses over the Cambo field. This corresponds to between one and two vessels per month passing along this route (Figure 5.30; Anatec, 2025).

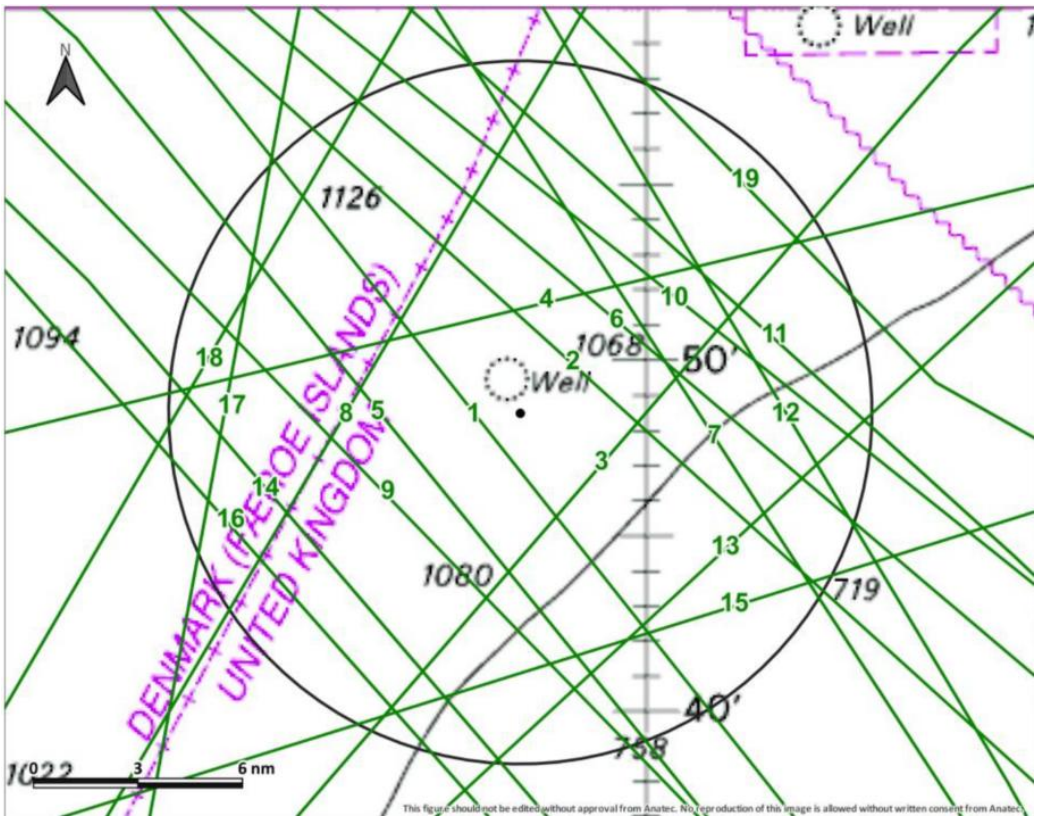
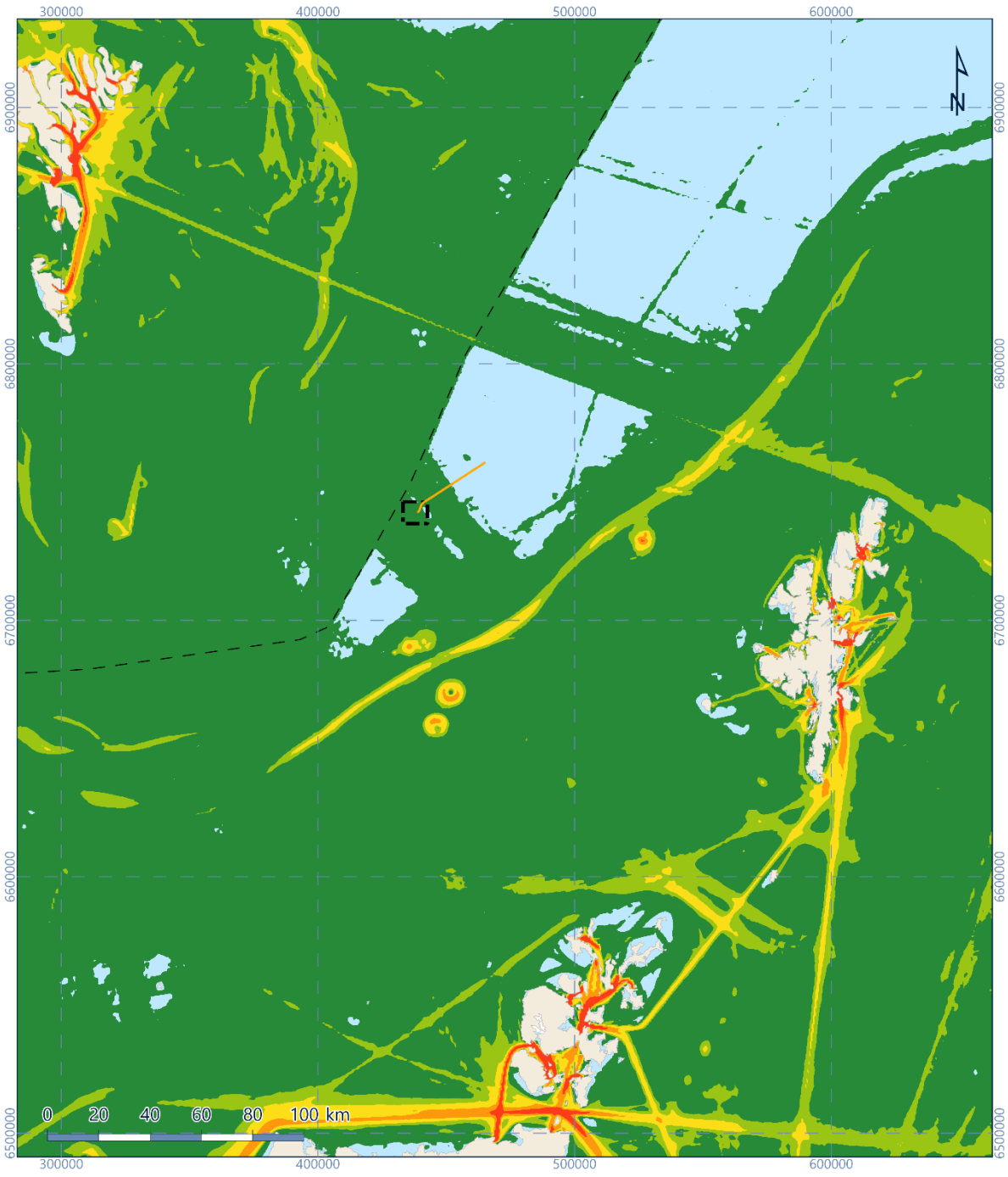


Figure 5.30: Location of shipping route within 10 nm of the Cambo field (Anatec, 2025)



Coordinate System: ED 1950 UTM Zone 30N; **Caveats:** Esri, 2025; Flanders Marine Institute (2023). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 12; EMODnet Human Activities and the European Maritime Safety Agency (EMSA), 2025.

Figure 5.31: Annual shipping route density in the vicinity of the Cambo field development

5.7.5 Military Activity

No Ministry of Defence (MoD) practice and exercise areas (PEXA) have been highlighted in the vicinity of the proposals (NMPi, 2025). Furthermore, the UKCS blocks within which project infrastructure would be located does not overlap with areas which require the MoD to be notified (NSTA, 2022a).

5.7.6 Wrecks and Archaeology

There are no identified wrecks or sites of archaeological interest within the proposed field development location (NMPi, 2025). The closest wreck to the Cambo field development is located 9 km northwest of the proposed pipeline, identified as the wreck of the steam ship Troldfos (UKHO, 2025).

5.7.7 Submarine Cables

The closest submarine cable to the Cambo field development in the Faroese Telecom's SHEFA-2 subsea cable, which crosses the proposed pipeline route approximately 22.8 km north of the FPSO and 9.3 km southwest of the end of the proposed pipeline (Figure 5.29). SHEFA-2 is a fibre optic submarine cable stretching 825 km from Hvítanes, Faroe Islands, to Manse Bay, Banff in Scotland via the Shetland and Orkney Islands. The SHEFA-2 cable is the main communications link to the Faroe Islands and provides connectivity to West of Shetland oil and gas platforms as well as to Shetland Islands and Orkney Islands communities (KIS-ORCA, 2025).

5.7.8 Renewable Energy Installations and Gas Storage/Carbon Capture and Storage (CCS) Areas

No offshore renewable energy developments are located in the vicinity of the Cambo field development and the wider West of Shetland (CES, 2025).

The Yell Sound Array, a tidal energy development in Shetland and currently in its pre-planning phase, is located approximately 164 km from the Cambo FPSO (CES, 2025). The Arven and Stoura windfarms are located approximately 205 km east of the Cambo FPSO and are currently at the pre-planning stage (CES, 2025).

There are no carbon capture and storage areas in the vicinity of the Cambo field development and in the wider region.

5.8 Climate Change

For most environmental impacts, the location of a project is important when determining a baseline scenario for which the effects of a project would be assessed against. However, as the emissions of greenhouse gases (GHGs) to the atmosphere will contribute to the overall cumulative global effects on climate, the location of the emissions is not relevant. Moreover, global climate change effects are not instantaneous but develop and persist over longer time periods than typically used when assessing environmental impacts. Therefore, a global baseline of GHGs and their effects on climate change over time is provided in this section, using a range of potential climate change scenarios and effects, as developed and framed by the international

panel for climate change (IPCC) and other (inter)national government agencies and institutions. As this baseline description extends into the future and therefore cannot be based on actual data, the most current published climate projection data available at the time of writing has been used to inform this section.

5.8.1 The Greenhouse Effect

The greenhouse effect is a natural process where Earth's atmosphere traps the Sun's heat, making the planet warm enough to support life. Sunlight warms the surface of the Earth and infrared radiation expelled into outer space is, ultimately, the way the Earth cools down. If the two are out of balance, then the surface of the Earth can warm up or cool down. Carbon dioxide (CO_2) and other greenhouse gases, such as methane (CH_4) and nitrous oxide (N_2O), can absorb and release infrared radiation and alter that balance (Met Office, 2025). While essential for life, an increase in these gases from human activities can intensify this effect, leading to global warming and climate change. Future warming depends on future GHG emissions, with cumulative net CO_2 dominating (IPCC, 2023). Together, CO_2, CH_4 and N_2O make up over 90 % of the GHGs when expressed in tonnes of carbon dioxide equivalent[1] (CO_2e).

Globally, CO_2 emissions from fossil fuel combustion (coal, oil and gas) account for approximately 68 % of current GHG emissions (UNEP, 2024).

Methane accounts for approximately 16 % of the warming effect of long-lived GHGs. Atmospheric methane has a lifetime of about a decade and is ultimately oxidized to CO_2 (Oh et al., 2025; WMO, 2025). 40 % of methane in the atmosphere comes from natural sources, such as wetlands, while human activities, such as rice agriculture, ruminants, fossil fuel exploitation, landfills and biomass burning, account for the remaining 60 % (WMO, 2025).

N_2O accounts for about 7 % of the warming caused by long-lived GHGs. Human-induced sources, such as fertilizer use and biomass burning, account for approximately 40 % of N_2O emissions (WMO, 2025).

5.8.2 Global GHG Emissions – Current Status and Trend

Figure 5.32 shows the amount of greenhouse gases emitted since the start of the industrial revolution, clearly indicating the continual increase of CO_2 emissions with the combustion of fossil fuels becoming the dominating contributor over time (IPCC, 2023).

[1] Carbon dioxide equivalent, or CO_2e, is a standard unit for measuring greenhouse gas emissions. It expresses the global warming potential (GWP) of different greenhouse gases in terms of the amount of CO_2 that would have the same impact over a specific period (usually 100 years). For example, CH_4 has a GWP of 28, meaning one tonne of methane has the same warming effect as 28 tonnes of CO_2, over a period of 100 years. Similarly, the GWP for N_2O is 265

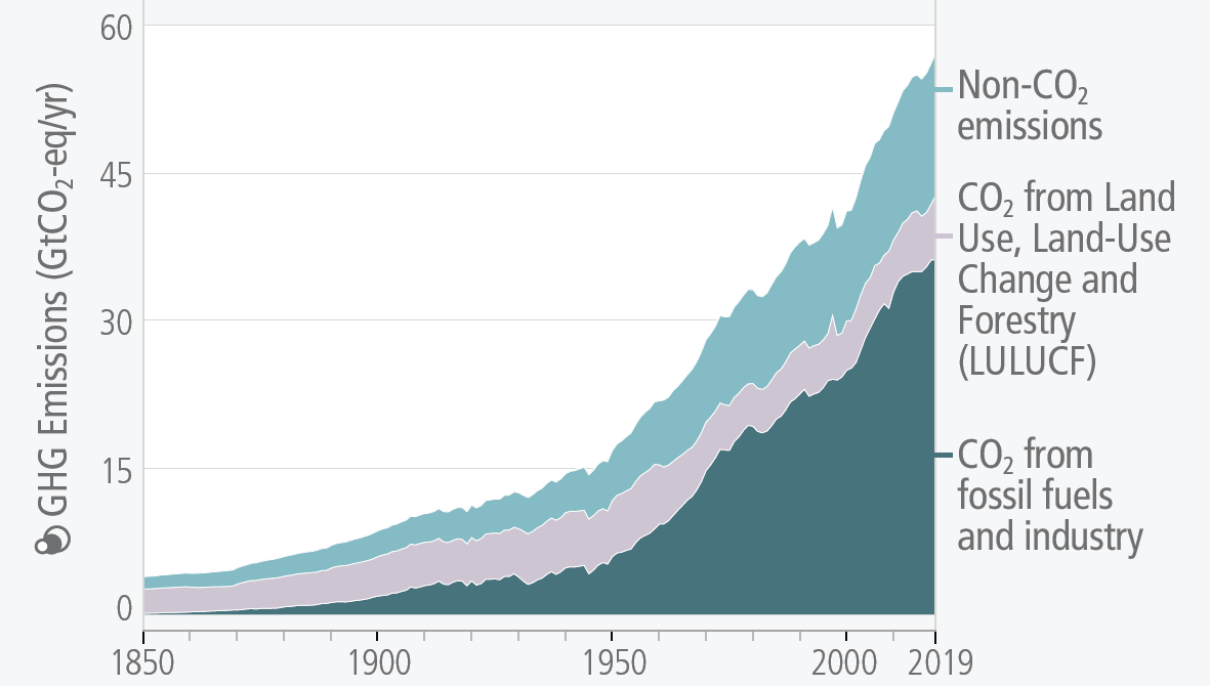


Figure 5.32: Global greenhouse gas emissions (source: IPCC, 2023)

CO_2 concentrations in the atmosphere vary throughout the seasons, largely due to the photosynthetic activity of plants. In the Northern Hemisphere, CO_2 levels peak in late spring and reach a low in late summer to early autumn. This pattern reflects the seasonal uptake of CO_2 by plants during their growing season and the release of CO_2 when photosynthesis slows in winter. The amplitude of these fluctuations is stronger at higher northern latitudes and weaker closer to the equator. In the Southern Hemisphere, where there is less land area, the seasonal CO_2 cycle is much weaker (Scripps, 2025).

However, direct measurements of CO_2 since the 1950s show that the concentrations have clearly increased and currently remains trending upwards (Figure 5.33). Using other sources of information, such as gas bubbles trapped in Antarctic ice, it is possible to measure greenhouse gas concentrations even further back in time. The concentration of CO_2 in the atmosphere has increased by around 46 % since pre-industrial times (Met Office, 2025).

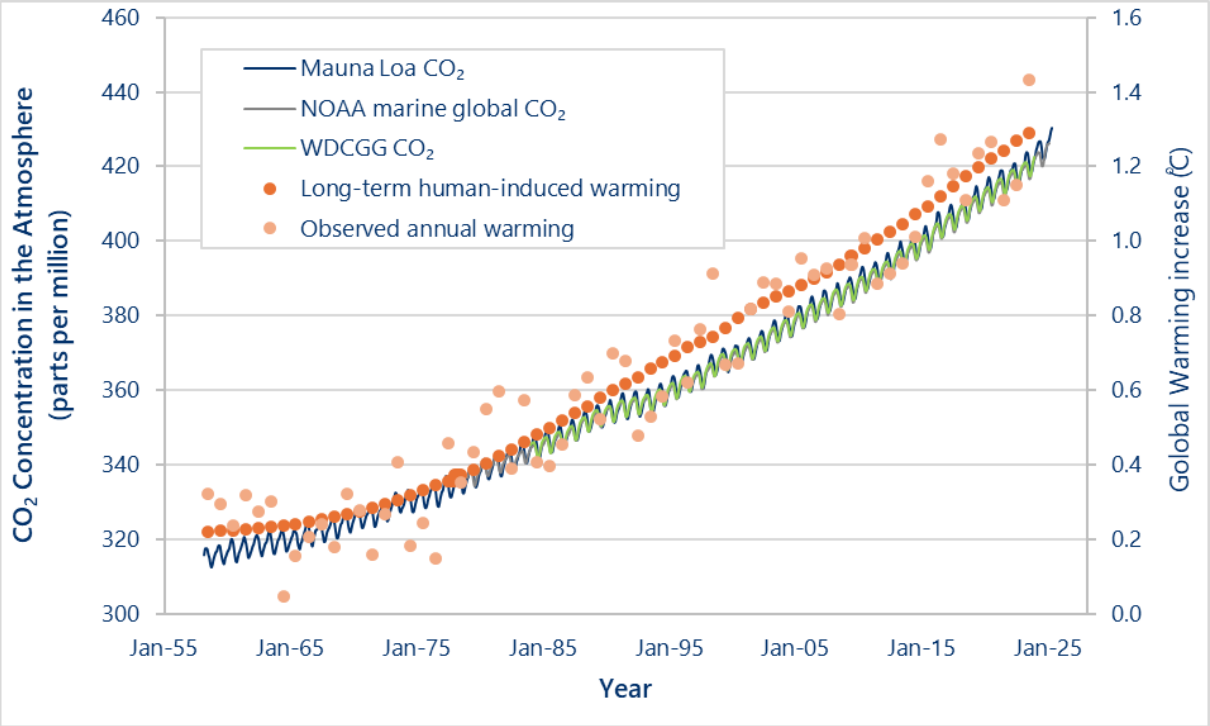


Figure 5.33: Monthly carbon dioxide in the atmosphere (Met Office, 2025) and Global Warming Increase (Smith et al., 2024 in CCC, 2025)

Overall GHG emissions (expressed as total CO_2e) are also continuing to increase, as indicated in Table 5.14.

Table 5.14: Total global GHG emissions

Year	CO_2e (Giga Tonnes)
1990	37.8
2000	41.5
2010	51.0
2020	53.7
2021	55.9
2022	56.3
2023	57.1
Notes Source: UNEP, 2024.	

5.8.3 Managing Climate Change Globally – The Paris Agreement

The Paris Agreement is a legally binding international treaty on climate change, which was adopted by 195 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015 and entered into force on 4 November 2016. The overarching goal of the agreement is to hold the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change. In order to achieve the long-term temperature goal, Parties to the Paris

Agreement aim to achieve a balance between anthropogenic emissions by sources and removals by (carbon) sinks of greenhouse gases in the second half of this century. However, in recent years, world leaders have stressed the need to limit global warming to 1.5 °C by the end of this century in response to the Intergovernmental Panel on Climate Change (IPCC) indicating that crossing the 1.5 °C threshold risks unleashing far more severe climate change impacts, including more frequent and severe droughts, heatwaves and rainfall. To limit global warming to 1.5 °C, greenhouse gas emissions must peak before 2025 at the latest and decline 43 % by 2030 (UNFCCC, 2024).

In order to achieve the targets set out in the Paris Agreement, all signatories (including the United Kingdom) have been tasked to outline and communicate their post-2020 climate actions, known as 'nationally determined contributions' (NDCs). Together, these climate actions determine whether the world is likely to meet the long-term goals of the Paris Agreement in order to:

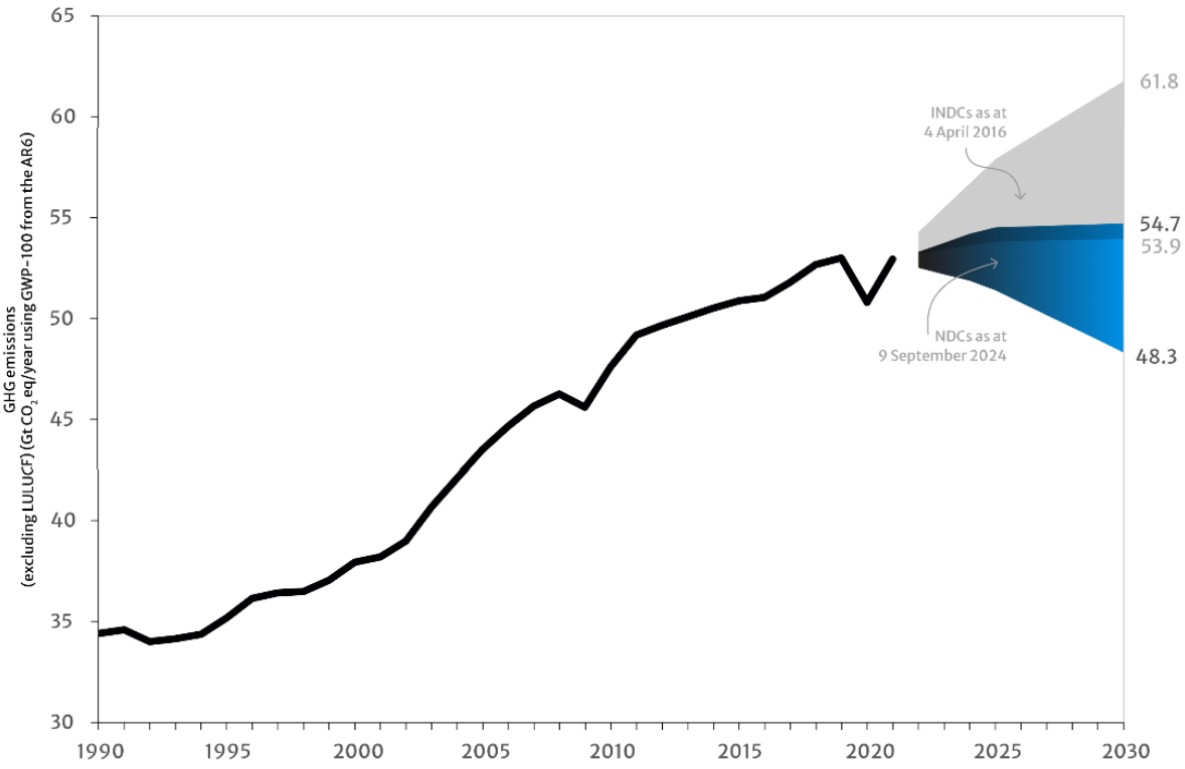
- Achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century;
- By reaching global peaking of GHG emissions as soon as possible; and
- To undertake rapid reductions thereafter in accordance with best available science.

NDCs are submitted every five years to the UNFCCC secretariat and each successive NDC is meant to reflect an increasingly higher degree of ambition compared to the previous version.

The 2024 NDC Synthesis Report (UNFCCC, 2024) shows that, global GHG emissions (without LULUCF[2]) taking into account implementation of the latest NDCs from 9 September 2024 are estimated to be around 51.5 (48.3–54.7) Gt CO_2e in 2030 (Figure 5.34).

The NDCs of 82 % of Parties (including the UK) are unconditional, at least in part, with many including more ambitious conditional elements. The implementation of most conditional elements depends on access to enhanced financial resources, technology transfer and technical cooperation, and capacity-building support; availability of market-based mechanisms; and absorptive capacity of forests and other ecosystems. When also taking into account the conditional NDC elements the reduction could be slightly lower at 49.8 (48.3-51.2) Gt CO_2e by 2030.

[2] These numbers do not include the GHG contribution from land use, land-use change and forestry (LULUCF). For comparison, the global emissions including LULUCF in 2030 are estimated as 55.2 (53.9–56.6) Gt CO_2e considering unconditional elements and 51.7 (50.2–53.1) Gt CO_2e assuming full implementation.



Note: INDCs (Intended Nationally Determined Contributions) were the climate action plans submitted before the Paris Agreement in 2015, while NDCs (Nationally Determined Contributions) are the updated, legally binding versions which were introduced with the Paris Agreement.

Figure 5.34: Projected range and progression of emission levels according to NDCs (Source: UNFCCC, 2024)

5.8.4 Managing Climate Change in the UK

As described in Section 5.8.3, each country that has signed up to the Paris Agreement has been tasked to set out a framework for domestic action to address climate change mitigation and adaptation, which has to be updated periodically and presented through their individual NDCs. In the UK this has been implemented through the Climate Change Act (2008). The Act requires the Government to propose regular (every 5 years), legally binding milestones on the way to achieving Net Zero greenhouse gas emissions, known as carbon budgets. In 2019, the UK committed itself to reach Net Zero greenhouse gas emissions by 2050, with any residual greenhouse gas emissions balanced by removals. The UK's target of Net Zero by 2050 is consistent with IPCC scenarios that limit warming to 1.5 ºC. NDCs and carbon budgets are set to define a feasible pathway to achieve this that is both ambitious in its pace and deliverable (CCC, 2025).

In order to achieve this ambitious goal, the UK government has set itself interim carbon targets on 5-year intervals, which are developed by the climate change committee (an independent advisory body to the government), before being agreed on by Parliament, turning these carbon budgets into legal obligations. The UK's sixth carbon budget (CB6) was implemented in law in June 2021 for the budget period 2033 - 2037 and the current proposed seventh carbon budget (CB7) covering the period of 2038 to 2042 is due to be legislated by June 2026.

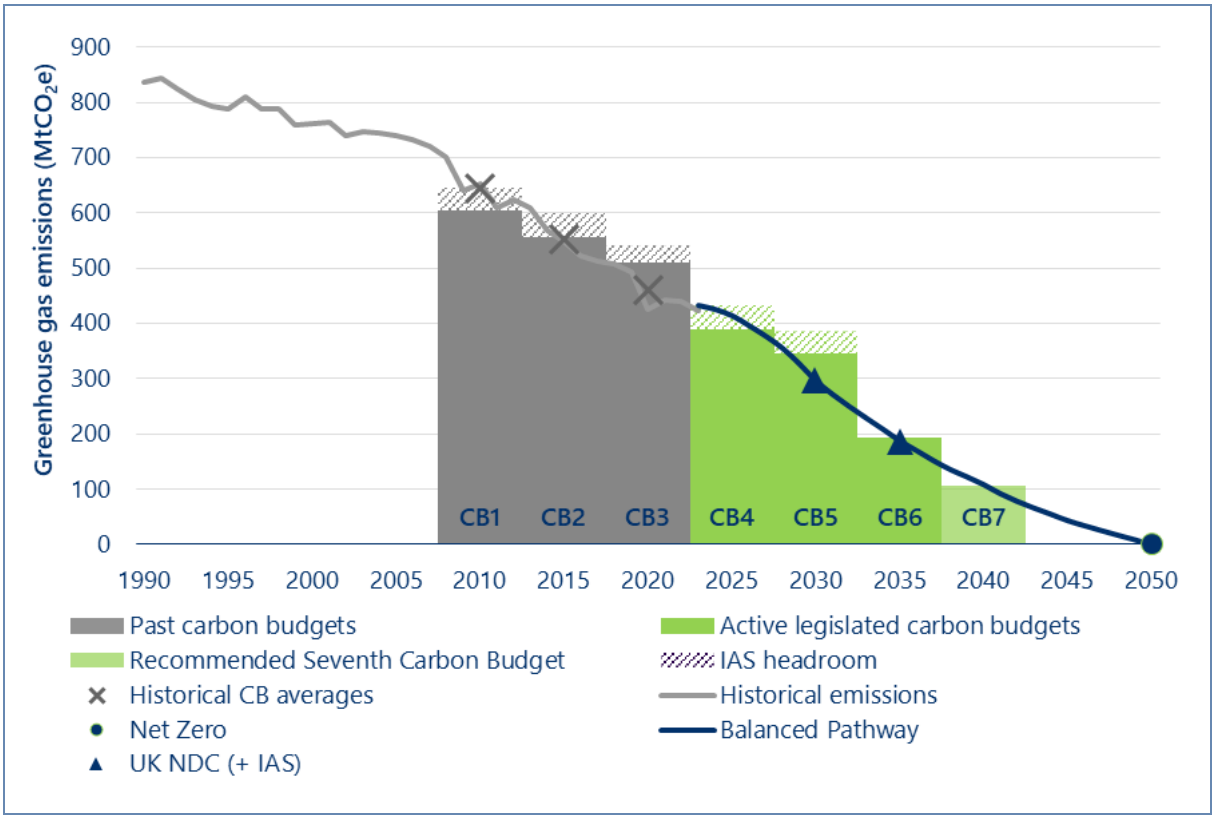
Table 5.15 and Figure 5.35 show the current and proposed UK carbon budgets for the country as a whole. The UK's First, Second, and Third Carbon Budgets, covering the period 2008 to 2022 were set based on the old 2050 target of an 80 % reduction in emissions. The UK has met all three initial targets, with GHG emissions having roughly halved since 1990 (CCC, 2025).

The next three steps on the way to Net Zero are the Fourth, Fifth and Sixth Carbon Budgets, covering the period 2023 to 2037. Whereas the Fourth and Fifth Carbon Budgets were still set based on the previous 80 % reduction target, the current Sixth Budget is set in line with Net Zero and is now also in line with the UK's 2030 and 2025 NDCs. As mentioned above, the seventh carbon budget will be added in 2026.

Table 5.15: UK Carbon Budgets

Carbon Budget	Budget Period	Current Status	UK Budget Allocation [Mt CO_2e]
1	2008-2012	Past Carbon Budget	3,018
2	2013-2017	Past Carbon Budget	2,782
3	2018-2022	Past Carbon Budget	2,544
4	2023-2027	Active Legislated Carbon Budget	1,950
5	2028-2032	Active Legislated Carbon Budget	1,725
6	2033-2037	Active Legislated Carbon Budget	965
7	2038-2042	Proposed Carbon Budget	535

Notes
Source: CCC, 2025.



Notes:
Source: DESNZ (2024a) Provisional UK greenhouse gas emissions national statistics 2023; DESNZ (2024b) Final UK greenhouse gas emissions national statistics: 1990 to 2022; CCC analysis.

(1) The pathway and baseline are modelled using historical data up to 2022 or 2023, depending on the sector. Projected emissions reductions prior to 2025 (shown in a pale shade in this chart) are based on existing trends; additional decarbonisation measures only begin from 2025.
(2) The gap between historical 2023 emissions and the modelling for that year is largely because the analysis assumes that some of the 2021-2023 emissions reduction from buildings was a short-term response to weather and high gas prices and because the shipping modelling is based on an activity-based estimate of emissions.
(3) Emissions from international aviation and shipping (IAS) are included in historical emissions and added to the first five carbon budgets and the two Nationally Determined Contributions (NDC) (in which they are not included).
(4) 'CB' refers to UK carbon budgets: 'CB1' refers to the First Carbon Budget; subsequent numbers refer to subsequent carbon budgets.

Figure 5.35: UK Carbon Budgets

5.8.5 Projected Global GHG Emissions

The level of future global GHG emissions and associated climate change is very hard to predict and historical observations alone are not suitable to forecast how much the climate will change over the coming decades or at the end of the century. The level of climate change over this period will be determined by the amount of greenhouse gases that will be emitted which, in turn, are strongly dependent on how society grows and develops. These growth patterns are influenced by a host of factors, including global cooperation on greenhouse gas reductions, political will, and technological advancements. Even seemingly small changes to any of these factors can result in very different outcomes. Therefore, rather than offering a single set of future climate data, it is considered best practice to provide a range of future climate scenarios that encompass various levels of greenhouse gas emissions (Climate Data Canada, 2025).

To evaluate the most likely range of potential future global warming levels the Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC AR6), a total of 1,202 modelling scenarios were used, which were split into eight categories (Table 5.16). It should be noted that these categories should not be interpreted as being fixed scenarios. Rather, they are potential storylines that are explored through a large number of individual quantitative scenarios created by climate and economic models. The number of scenarios in each category provides some insight into the current literature, but this does not indicate a higher probability of that category occurring in reality (Riahi et al., 2022).

Table 5.16 also shows how these categories relate to the five 'illustrative' Shared Socio-economic Pathways (SSPs) used extensively by the IPCC in AR6. These specific SSPs are used to represent five potential futures and are based on broad socioeconomic trends such as population, technological, and economic growth that could shape future society, in combination with a target level of atmospheric greenhouse gas concentrations in 2100.

Table 5.16: Classification of emissions scenarios into global warming levels

Category	Description	SSP	Scenarios Modelled
C1: Limit warming to 1.5 °C (> 50 %) with no or limited overshoot	Reach or exceed 1.5 °C during the 21st century with a likelihood of ≤ 67 %, and limit warming to 1.5 °C in 2100 with a likelihood > 50 %. Limited overshoot refers to exceeding 1.5 °C by up to about 0.1 °C and for up to several decades.	SSP1-1.9	97
C2: Return warming to 1.5 °C (> 50 %) after a high overshoot	Exceed warming of 1.5 °C during the 21st century with a likelihood of > 67 %, and limit warming to 1.5 °C in 2100 with a likelihood of > 50 %. High overshoot refers to temporarily exceeding 1.5 °C global warming by 0.1 °C – 0.3 °C for up to several decades.		133
C3: Limit warming to 2 °C (> 67 %)	Limit peak warming to 2 °C throughout the 21st century with a likelihood of > 67 %.	SSP1-2.6	311
C4: Limit warming to 2 °C (> 50 %)	Limit peak warming to 2 °C throughout the 21st century with a likelihood of > 50 %.		159
C5: Limit warming to 2.5 °C (> 50 %)	Limit peak warming to 2.5 °C throughout the 21st century with a likelihood of > 50 %.		212
C6: Limit warming to 3 °C (> 50 %)	Limit peak warming to 3 °C throughout the 21st century with a likelihood of > 50 %.	SSP2-4.5	97
C7: Limit warming to 4 °C (> 50 %)	Limit peak warming to 4 °C throughout the 21st century with a likelihood of > 50 %.	SSP3-7.0	164
C8: Exceed warming of 4 °C (≥ 50 %)	Exceed warming of 4 °C during the 21st century with a likelihood of ≥ 50 %.	SSP5-8.5	29
C1, C2, C3: limit warming to 2 °C (> 67 %) or lower	All scenarios in Categories C1, C2 and C3		541

Notes:
Source: Riahi et al., 2022.

The five 'illustrative' SSPs used in the IPCC AR6 assessment report (IPCC, 2021) are SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5, whereby SSP1-1.9 represents a low-emissions scenario (based on the implementation of a high level of climate mitigation measures), whilst SSP 5-8.5 represents the highest level of emissions with minimal mitigation.

The five illustrative scenarios are written in a SSPx-y format, where 'x' refers to the particular set of socioeconomic assumptions driving the emissions and other climate forcing inputs used by climate models, and 'y' refers to the approximate level of radiative forcing (in watts per square metre, or W m^{-2}) resulting from that specific scenario in the year 2100 (and therefore, effectively, the amount of warming that could occur by the end of the century).

Of the 1,202 scenarios modelled, 541 scenarios (i.e. the scenarios modelled under categories C1, C2 and C3) would effectively meet the target of limiting global warming to 'well below' 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C as set out in the Paris Agreement.

Figure 5.36 shows these five possible future pathways for yearly global carbon dioxide emissions (left) and their resulting atmospheric carbon dioxide concentrations (right) through the end of the century. For simplicity, the image only shows the mean value predicted by the models for each pathway, not the full range of uncertainty (Lindsey, 2025).

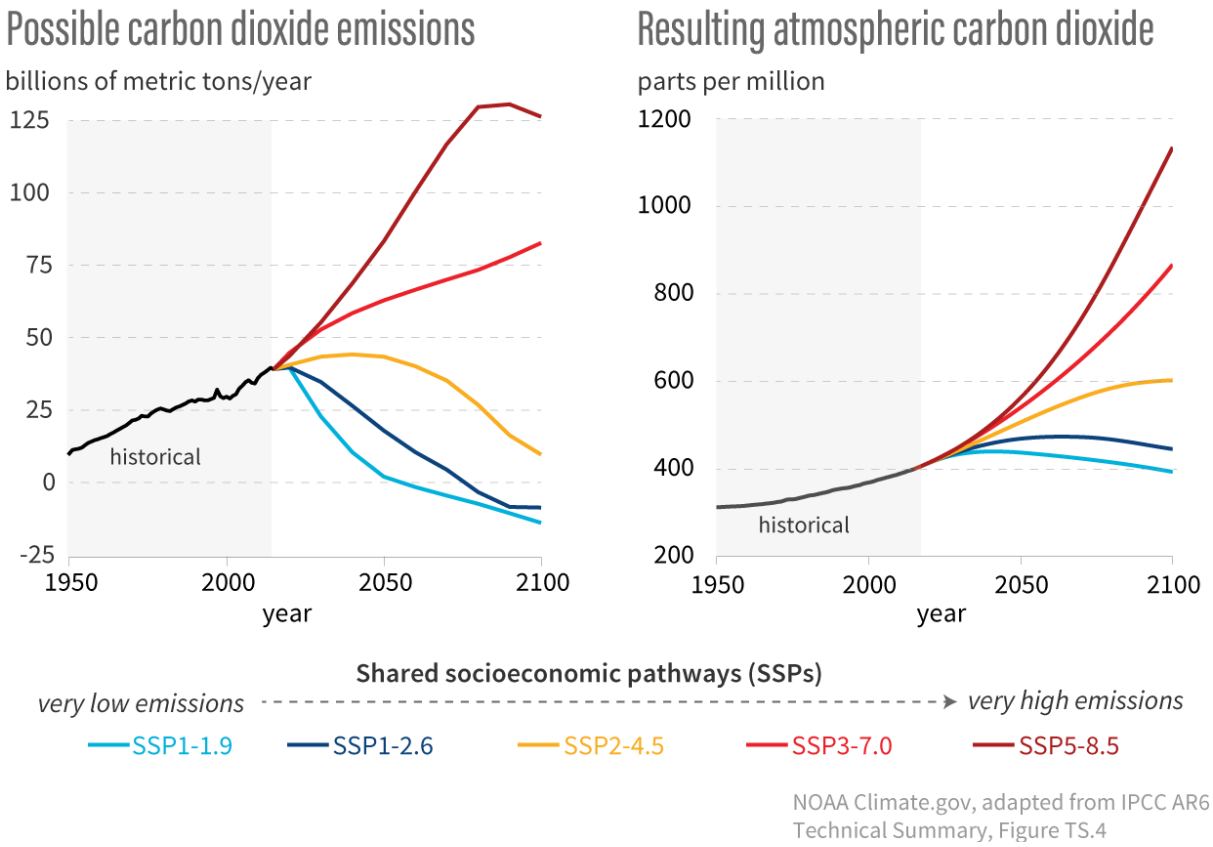


Figure 5.36: Five potential future emission scenarios and resulting atmospheric CO_2 levels

The figures show that global GHG emissions have continued to rise to 2019. The growth of global GHG emissions has slowed over the past decade, and delivering the current NDCs to 2030 would turn this into decline. However, the implied global emissions by 2030 exceed pathways consistent with 1.5 °C by a large margin, and are near the upper end of the range of modelled pathways which keep temperatures likely limit warming to 2 °C (with > 65 % probability) (IPCC, 2023).

Predictions beyond 2030 become increasingly more challenging and uncertain, and will largely depend on how successful the implementation of the NDC commitments will be over the next 5 years until 2030, and how much they will improve after that.

Global warming will continue to increase in the near term in nearly all considered scenarios and modelled pathways. Deep, rapid, and sustained GHG emissions reductions, reaching net zero CO_2 emissions and including strong emissions reductions of other GHGs, in particular CH_4, are necessary to limit warming to 1.5 °C (> 50 %) or less than 2 °C (> 67 %) by the end of century (IPCC, 2023).

5.8.6 Global Climate Change Effects

It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred (IPCC, 2023). Human-caused climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones has been reported in recent years.

Figure 5.37 and Figure 5.38 provide a summary of the impacts of climate change on human and natural systems that have been observed around the world to date.

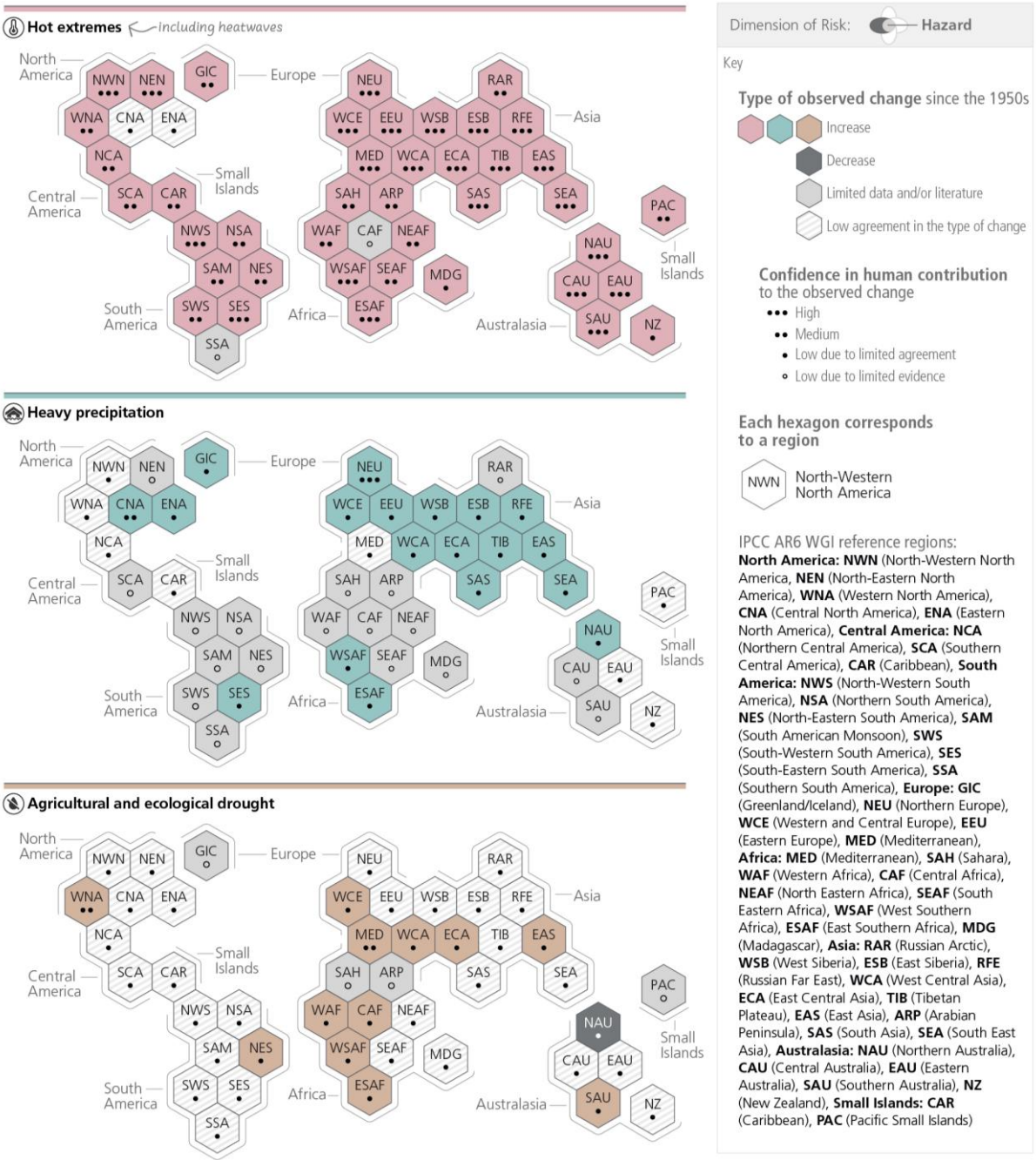


Figure 5.37: Synthesis of observed climate change effects to date around the world (IPCC, 2023)

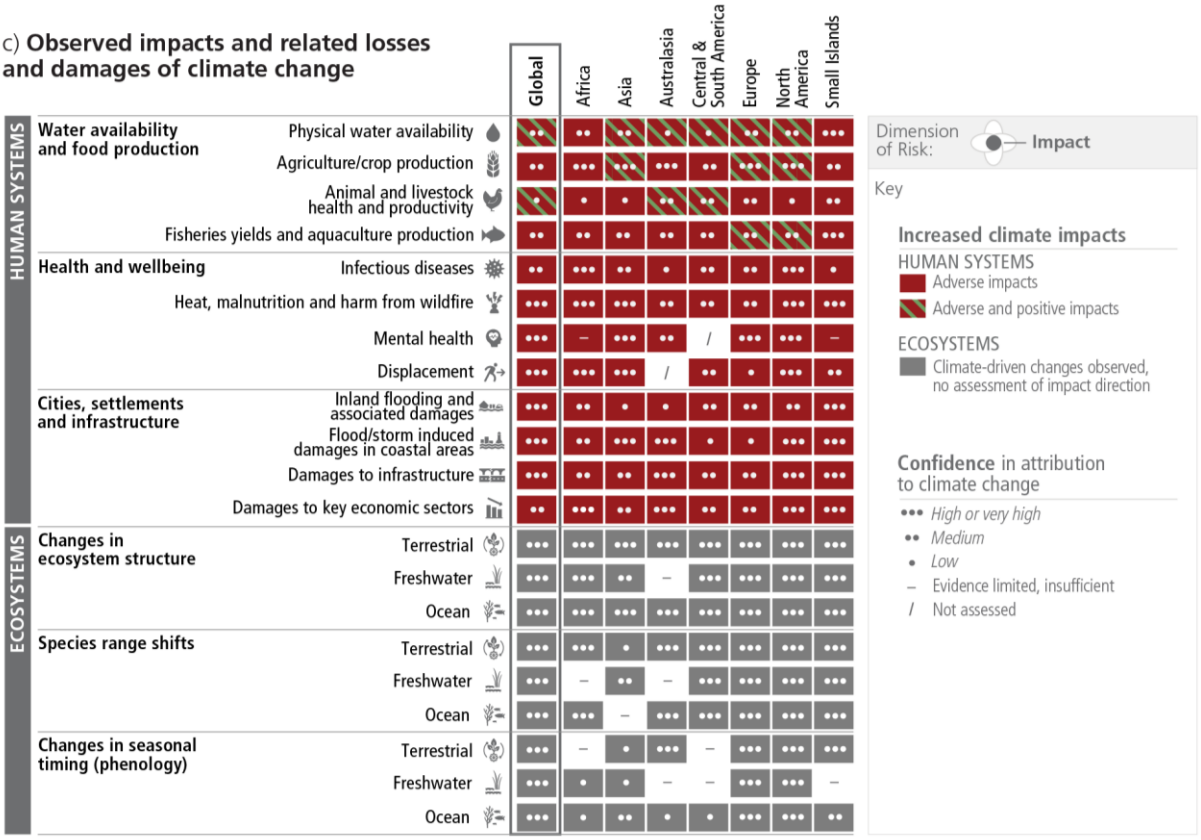


Figure 5.38: Observed impacts and related losses and damages of climate change to date (IPCC, 2023)

As introduced in Section 5.8.5, the 2021 IPCC report on Climate change (IPCC, 2021) has illustrated 5 future scenarios of climate response starting from 2015 which reflect the range of possible development of anthropogenic drivers of climate change until 2100. These different scenarios have been assessed for several chemical, physical, and biological processes affected by the increased concentration of GHGs in the Earth's atmosphere, the most conspicuous being:

- Rising global mean land-surface air temperatures and mean sea-surface temperatures;
- Mean sea level change;
- Changes in the ocean surface pH, also referred to as ocean acidification;
- Changes in land ice mass extent;
- Precipitation level changes; and
- Extreme weather events intensity and frequency changes.

A direct effect of increased GHG and CO_2 emissions in the atmosphere is a change in the global surface temperature, both on land and sea. Increasing global surface temperatures is linked to changes in several other ecological processes and systems, including increasing the species extinction risk, biodiversity loss, melting of ice caps, sea level rise, decreasing the ocean carbon capture capability and more (IPCC, 2021).

According to the modelled scenarios shown in Figure 5.39, global surface temperatures are predicted to continue to rise until the middle of this century in all scenarios. Particularly, after 2050, the low (SSP1-2.6) and very low (SSP1-1.9) scenarios start to flatten out before slowly starting to go down, although surface temperatures are still very likely to be higher than current levels by 1.0 °C to 1.8 °C. Under the intermediate emissions scenario (SSP2-4.5), temperatures are likely to exceed the current levels by 2.1 °C to 3.5 °C. High (SSP3-7.0) and very high (SSP5-8.5) scenarios will see surface temperature continuing to increase, up to 5.7 °C more than current levels (IPCC, 2021).

Land ocean contrasts are certain to continue to occur under current predictions, with temperatures on land set to increase 1.4 to 1.7 times more than the ocean surface (Lee et al., 2021). As reported by Byrne & O'Gorman (2018), average temperature over land have increased by 42 % more than over the ocean between 1979 and 2016 and this trend is likely to continue in all global surface temperature change scenarios assessed.

Additionally, the Arctic region will experience an increase in surface temperature two times above the rate of global averages under all presented scenarios (Lee et al., 2021). This phenomenon is known as polar amplification and has been observed in parallel to changes in sea ice extent, as well as changes in atmospheric and ocean heat transport and cloud cover (Serreze & Barry, 2011).

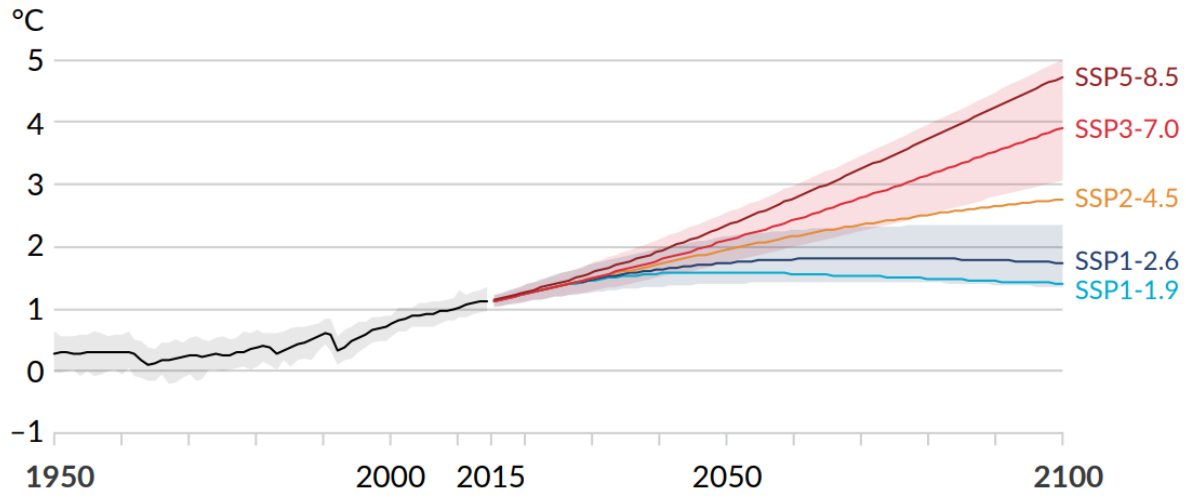


Figure 5.39: Global surface temperature change relative to the period 1850–1900 (Source: IPCC, 2021)

Sea level rise has been linked to the thermal expansion of the ocean due to warming of its waters and melting of ice stored on land as glaciers and ice sheets, which have been exacerbated by global warming driven by human activities (Fox-Kemper et al., 2021). Global mean sea level changes over the 20th century have been primarily affected by the loss of inland ice mass from glacier (52 %) and from the Greenland Ice Sheet (29 %), whilst thermal expansion only contributed to 32 % of this change (Fox-Kemper et al., 2021).

Under current predicted scenarios, as shown in Figure 5.40, the global mean sea level will continue to rise throughout this century. In particular, sea level will increase between of 0.28 m

(SSP1-1.9) and 1.01 m (SSP5-8.5) under the GHG emissions scenarios assessed (IPCC, 2021). In the longer term, the rise in mean sea level will continue for centuries to millennia and it would take thousands of years under significantly large net negative emissions to reverse this process (Ehlert & Zickfeld, 2018).

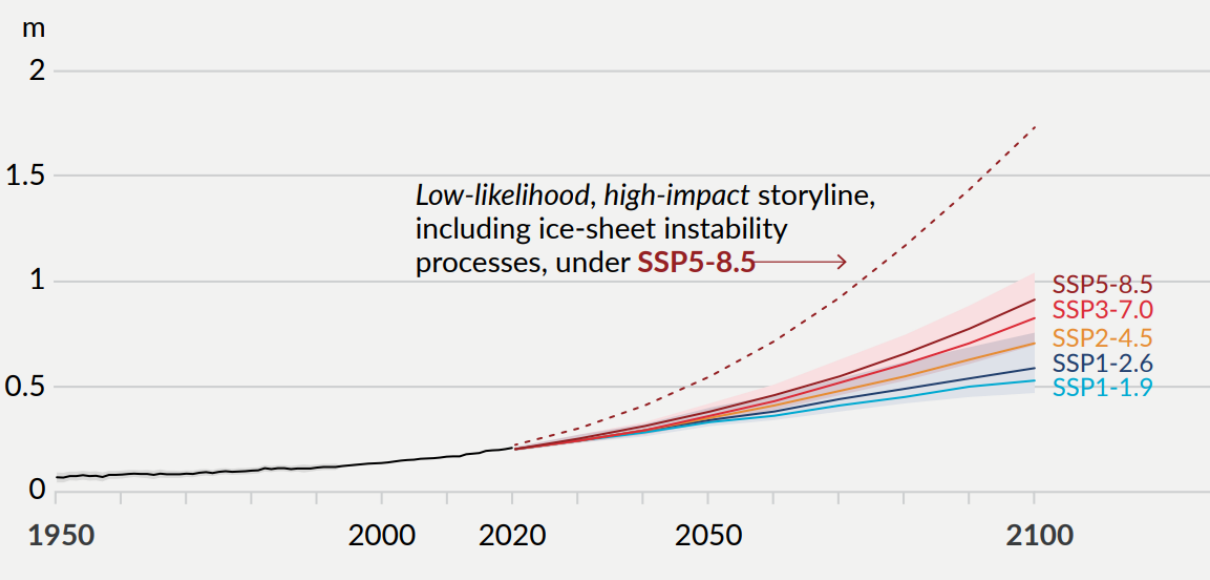


Figure 5.40: Global mean sea level change relative to 1900 (Source: IPCC, 2021)

The global ocean is a natural carbon sink for anthropogenic emissions of CO_2. As increasing CO_2 levels are present in the atmosphere and are absorbed by seawater, the concentration of carbon dioxide in the ocean also increases. The additional uptake of CO_2 through the ocean-atmosphere system triggers a series of chemical reactions causing a decrease in the ocean's pH levels (Gruber et al., 2019). This process is knowns as ocean acidification. Ocean acidification is concurrent to sea temperature rise, decreasing oxygen levels, changes in nutrients availability, and threatens marine organisms by reducing the saturation state of calcium carbonate, which is a component of skeletal structures and shells (Bopp et al., 2013; Gattuso et al., 2015).

Based on the modelled emission scenarios, shown in Figure 5.41, the global ocean surface pH is set to continue decreasing under the intermediate (SSP2-4.5), high (SSP3-7.0), and very high (SSP5-8.5) scenarios through the 21st century. Under the very low (SSP1-1.9) and low (SSP1-2.6) scenarios, pH will decrease before slightly increasing around 2100.

Under the scenarios predicting increasing emissions in the atmosphere, the reduction in pH will result in the ocean carbon sink being less effective, as the proportion of absorbed CO_2 will decrease with increasing CO_2 emissions (Canadell et al., 2021). Moreover, the largest pH decline and decrease in carbonate saturation are expected to be observed in the polar oceans (Jiang et al., 2019).

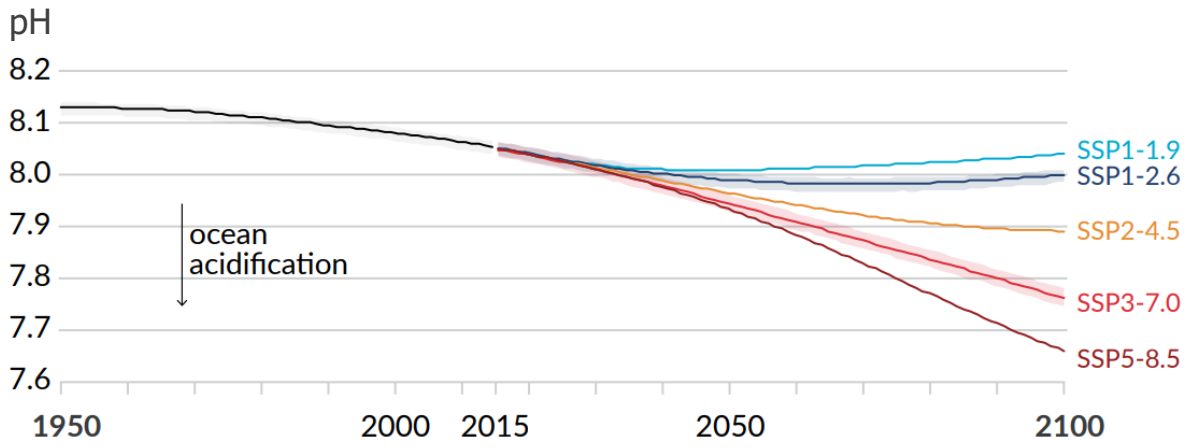


Figure 5.41: Global ocean surface pH (a measure of acidity) (Source: IPCC, 2021)

Climate change directly affects the extent of inland ice mass extent, mainly consisting of Arctic and Antarctic sea ice, Greenland and Antarctic icesheets, glaciers, permafrost and seasonal snow cover around the world. The global increase in temperatures has led to a reduction of ice mass extent globally (Fox-Kemper et al., 2021). The Greenland and Antarctic icesheets have already lost between 4890 Gt (gigatonnes) and 2670 Gt over the period 1992 – 2020, respectively. Glaciers have experienced a loss of 6200 Gt of mass between 1993 and 2019, and increases in permafrost temperatures have been reported over the last four decades. Similarly, the extent of spring snow cover in the Northern Hemisphere has been decreasing sing at least 1978 (Fox-Kemper et al., 2021).

The reduction in snow and ice cover on the planet reduces the amount of sunlight being reflected back into space, thus, trapping more heat in the atmosphere and accelerating global temperature rises. Furthermore, large stores of carbon are thought to be present in the frozen soils and permafrost of the Arctic, and increased decomposition as soils thaw and warm could mean that the Arctic will become a significant source of both atmospheric methane and carbon dioxide (Oh et al., 2025).

According to assessed emission scenarios, as presented in Figure 5.42, the Arctic sea ice area is expected to decrease under all considered scenarios (IPCC, 2021). Additionally, the Arctic will be practically sea ice free (sea ice area less than 1 million km^2) in September from 2050 under the intermediate (SSP2-4.5), high (SSP3-7.0), and very high (SSP5-8.5) scenarios. Sea ice area is also set to decrease in March when annual coverage will be at its maximum, under all scenarios (IPCC, 2021).

Similarly, polar icesheets, glaciers, and Northern Hemisphere snow cover will continue to lose mass under all scenarios considered throughout the 21st century (Fox-Kemper et al., 2021). Permafrost is also expected to experience increasing thaw and degradation until 2100 under all scenarios.

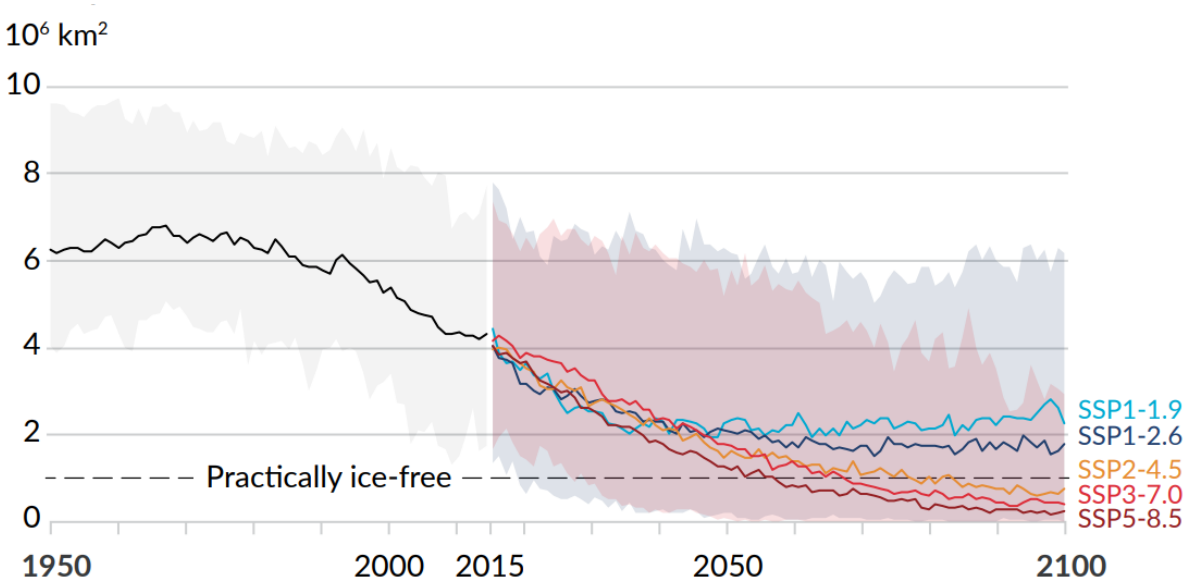


Figure 5.42: September Arctic sea ice area (Source: IPCC, 2021)

Climate change induced by anthropogenic emissions also affects precipitation, causing increases in frequency and intensity of precipitations over certain parts of the world and decreases in other regions. Significant increases in precipitations have been recorded over eastern North America, southern South America, northern Eurasia, and northwest Australia, whilst decreases have been mostly observed across southern Asia and western to equatorial Africa between 1901 and 2019 (Gulev et al., 2021). Increases in precipitations intensity and frequency, particularly of rainfall, can lead to flooding, landslides, and flash flooding (Chan et al., 2016; Gariano & Guzzetti, 2016). Conversely, a decrease in precipitation over certain regions can lead to droughts, impacting agriculture, water resources, and causing plant mortality (Fontes et al., 2018).

Considering the assessed emissions scenarios, the average annual global land precipitation significantly differs both geographically and seasonally. Precipitations are expected to increase over high latitudes and monsoon regions, whilst they are predicted to decrease over the subtropics, including Mediterranean and southern Africa. However, global mean precipitations are projected to increase by approximately 2.0 % under the very low scenario (SSP1-1.9) and 6.5 % under the very high scenario (SSP5-8.5) by the end of the current century (IPCC, 2021).

Climate change and its related effects, such as increasing precipitations and temperature increases, will also exacerbate extreme weather events, including tropical cyclones, tornadoes and other severe local storms, floods, heatwaves, droughts, wildfires and cold events (Seneviratne et al., 2021). These can be short-term events, such as tropical cyclones, or events that can extend over several months or years such as droughts. Some extreme events bring substantial loss of life or population displacement, others may have limited casualties but major economic impacts (WMO, 2020). These extreme weather events are expected to increase in frequency and intensity with increasing global warming levels.

Projected changes in the frequency of occurrence and intensity of some of these extreme weather events in relation to additional increments of global warming are summarised in Table 5.17.

Table 5.17: Projected changes in extremes frequency and intensity with every additional increment of global warming

	1850-1900	Present	Future global warming levels		
		1°C	1.5°C	2°C	4°C
Hot temperature extremes over land (10-year and 50-year events)					
Frequency per 10 years	1×	2.8×	4.1×	5.6×	9.4×
Intensity Increase	--	+1.2 °C hotter	+1.9 °C hotter	+2.6 °C hotter	+5.1 °C hotter
Frequency per 50 years	1×	4.8×	8.6×	13.9×	39.2×
Intensity Increase	--	+1.2 °C hotter	+2.0 °C hotter	+2.7 °C hotter	+5.3 °C hotter
Heavy precipitation over land (10-year event)					
Frequency per 10 years	1×	1.3×	1.5×	1.7×	2.7×
Intensity Increase	--	+6.7 % wetter	+10.5 % wetter	+14 % wetter	+30.2 % wetter
Agricultural & ecological droughts in drying regions (10-year event)					
Frequency per 10 years	1×	1.7×	2.0×	2.4×	4.1×
Intensity Increase	--	+0.3 sd drier	+0.5 sd drier	+0.6 sd drier	+1.0 sd drier

Notes:
Source: IPCC (2021).

5.8.7 Climate Change Effects in the UK

The changes in the UK climate that are currently already observed are projected to continue and intensify. In the second half of the century, the amount of change that occurs will depend strongly on how successful the measures to reduce greenhouse gas emissions globally are.

Table 5.18 shows the projected changes in some climate variables for England (ENG), Northern Ireland (NI), Scotland (SCO) and Wales (WAL), based on the 2018 UK probabilistic climate projections. These values quoted in the table represent a central (median) estimate of 30-year average change in each variable from a 1981-2000 baseline. Two emissions scenarios (Representative Concentration Pathways, or RCPs) are used, with RCP2.6 being roughly equivalent to a global warming +2 °C above pre-industrial scenario by 2100 and RCP6.0 being roughly equivalent to a global warming +4 °C above preindustrial levels by 2100. The exception is Sea Level Rise, where the RCP8.5 scenario is used, as for marine projections this is closer to a +4 °C global warming scenario. The full likely range of change (i.e. 10 – 90th percentile) in each average variable is not shown here but is available from the full UKCP18 database. It is

important to note that because these projections show average changes for a 30-year period and only the central estimate, changes in individual years would show a much greater range of change and could be significantly higher (or lower).

Table 5.18: Climate change effects in the UK

Climate Change Effect	Country	2050s RCP2.6 (50th percentile)*	2050s RCP6.0 (50th percentile)*	2080s RCP2.6 (50th percentile)*	2080s RCP6.0 (50th percentile)*
Annual Temperature	ENG	+1.3 °C	+1.2 °C	+1.4 °C	+2.4 °C
	NI	+1.1 °C	+1.2 °C	+1.2 °C	+2.1 °C
	SCO	+1.1 °C	+1.0 °C	+1.1 °C	+2.0 °C
	WAL	+1.2 °C	+1.1 °C	+1.3 °C	+2.3 °C
Summer Rainfall	ENG	-15 %	-14 %	-15 %	-22 %
	NI	-11 %	-11 %	-10 %	-15 %
	SCO	-7 %	-6 %	-12 %	-16 %
	WAL	-15 %	-15 %	-18 %	-26 %
Winter Rainfall	ENG	+6 %	+6 %	+8 %	+13 %
	NI	+3 %	+3 %	+7 %	+10 %
	SCO	+7 %	+7 %	+7 %	+13 %
	WAL	+6 %	+5 %	+7 %	+13 %
Sea level rise**	ENG	+23 cm	+29 cm	+45 cm	+78 cm
	NI	+14 cm	+16 cm	+27 cm	+58 cm
	SCO	+12 cm	+18 cm	+23 cm	+54 cm
	WAL	+22 cm	+28 cm	+43 cm	+76 cm

Notes:
Sources: Climate Northern Ireland, 2021; Netherwood, 2021; Sniffer, 2021; Sustainability West Midlands, 2021.

* RCP values refer to the 'Representative Concentration Pathways' and are analogous to the 'y' values used in the SSPx-y scenarios used in AR6, i.e. they are scenarios for the future that project greenhouse gas concentrations and their resulting impact on the climate, expressed in watts per square metre (w/m^2). RCP2.6 (50th percentile) refers to a climate change scenario with a central estimate for low-emission futures, where greenhouse gas emissions are assumed to peak and then decline significantly, leading to a warming of around 2.6 w/m^2 above pre-industrial levels with global temperature rises expected to remain below 2 °C. RCP6.0 represents a medium-range greenhouse gas emissions pathway projecting a global temperature rise of approximately 3 to 4 °C by 2100 above pre-industrial levels. This scenario assumes that greenhouse gas emissions peak around 2080 and then decline, stabilizing at a radiative forcing level of 6.0 w/m^2 after 2100 and projects a global temperature rise of approximately 3–4 °C by 2100 above pre-industrial levels.
** As sea level rises will be very location specific around the UK shores, only one representative location from each of the four countries has been selected to represent each of the four nations, namely: Belfast, Cardiff, Edinburgh and London.

Annual average temperatures are projected to rise. Risks associated with rising temperatures, such as extreme heatwave events causing impacts on people's health and wellbeing, are likely to become more prevalent, with their magnitude depending on the degree of change that is experienced. Although temperatures are projected to increase in both summer and winter, warming is expected to be greatest in summer. Summer rainfall is projected to decrease, although extreme downpours will be heavier despite the overall drying trend.

The change in expected rainfall is projected to lead to an increase in flooding of infrastructure, businesses and homes. Conversely, as overall summer rainfall is projected to decrease, periods of water scarcity are likely to become more prevalent under these scenarios, leading to possible implications in agriculture and industry, for example.

Winters are projected to become wetter, both in terms of total amount of rainfall and the number of wet days.

Sea level rises will be very location specific, and the examples provided in the table for Belfast, Cardiff, Edinburgh and London should just be seen as 'typical' examples for each of the four nations. Such rises would lead to an increase in likelihood of associated risks, such as flooding of coastal communities.

5.9 Summary

Table 5.19 provides a summary of the key environmental sensitivities identified throughout this Section for the proposed Cambo field development.

Table 5.19: Seasonal variation of key environmental sensitivities

Parameter	Environmental Sensitivities											
	J	F	M	A	M	J	J	A	S	O	N	D
Plankton	Phytoplankton productivity in the West of Shetland area is highest in the spring and autumn with a major peak around May and a lesser peak in August. Zooplankton productivity follows a similar pattern, but the blooms follow approximately one month later.											
Benthos	Life cycles of organisms within the seabed communities are not well understood. Seasonal blooms of phytoplankton can provide a food source for larvae, influencing the timing of spawning events. No issues were identified with sediment chemistry in the proposed FPSO location and along the proposed gas export route.											
Fish and shellfish	There are no spawning grounds which fall directly within the Cambo field development, however, spawning grounds for blue whiting are found near the proposed field development, with peak spawning time occurring between February and May. The Cambo field development also lies within in a year-round high intensity nursery ground for blue whiting. Sharks and skate species of international and national conservation importance are likely present within the Cambo field development for foraging, breeding and migration purposes.											
Marine mammals	The waters of Faroe-Shetland channel support a number of important and diverse populations of both resident and migratory marine mammals. Numerous species have been reported in water depths similar to the area of proposals including, fin whale, killer whale, long-finned pilot whale, minke whale, Risso's dolphin, sperm whale and Atlantic white-sided dolphin. December to May appears to be the period of the year with most sightings of most species using the area for foraging and migration purposes.											

Parameter	Environmental Sensitivities											
	J	F	M	A	M	J	J	A	S	O	N	D
Seabirds	Birds will generally move through the Faroe-Shetland Channel in autumn and spring to reach their breeding grounds and colonies. Seabirds are present throughout the year in the Faroe-Shetland Channel, with mostly low to moderate densities found in the proposed Cambo field development. However, the fulmar, were found in high densities in the Cambo field development area from October to February.											
Coastal conservation	Most of the coastal conservation areas are designated for the presence of birds and seals. The Shetland and Orkney Islands are of international ornithological significance, particularly as seabird breeding sites, and as such many coastal sites on the islands are designated as SPAs and IBAs. There are also a number of SACs designated for major common seal breeding sites and for the otter population.											
Offshore conservation	The Cambo FPSO is located approximately 16 km from the Faroe-Shetland Sponge Belt NCMPA and approximately 69 km northwest of the Seas off Foula SPA. No other offshore conservation areas are found within a 100 km from the proposed field development.											
Other users of the sea	Due to the remoteness and deep waters of the Cambo field development, oil and gas activity, shipping, and fishing are low in the proposed area of development.											
Climate Change	The atmospheric concentration of GHGs is classed as being of high sensitivity to all further emissions.											

Key	No Data		No Animals	L	Low	M	Moderate	H	High	VH	Very High

All UKCS licence Blocks have been accessed by JNCC, MS and CEFAS with regards to their environmental sensitivity throughout the year for seismic surveys and drilling operations, particularly with regard to fish spawning for seismic surveys and seabird vulnerability to oil pollution for drilling operations (NSTA, 2022a). No periods of concern have been identified for drilling operations within the proposed Cambo field development.

6. Identification of Impacts

This Section describes the scoping methods used to identify the environmental interactions and concerns associated with the proposed Cambo field development that could potentially cause a significant environmental impact. The following three scoping methods were used:

- Informal scoping consultation with the statutory consultees and other stakeholders;
- An environmental issues identification (ENVID) workshop by members of the project team;
- A review of national policies and guidance, including:
  - The Scottish National Marine Plan (NMP) policies relating to the potential impacts from oil and gas activity; and
  - The sensitive features of the local environment and corresponding relevant pressures from the proposed development based on Feature Activity Sensitivity Tool (FeAST), where appropriate.

The purpose of these scoping activities was to identify the main environmental concerns at an early stage of the project, so that they could be addressed and mitigated against during the environmental impact assessment (EIA) process.

6.1 Informal Stakeholder Consultation

Informal consultation was carried out with a number of key stakeholders, including the following statutory consultees:

- The Offshore Petroleum Regulator for Environment and Decommissioning (OPRED);
- Marine Scotland (now Marine Directorate);
- Joint Nature Conservation Committee (JNCC).

As part of the early consultation process, a Scoping Report (Fugro, 2018) was sent to all three statutory consultees, and followed up with a meeting with OPRED, Marine Scotland and JNCC on 23 March 2018, in which an overview of planned activities for the proposed Cambo field development was presented and the consultees were invited to provide any comments or concerns they might have in relation to the proposed operations.

A separate meeting was held with the Scottish Fishermen's Federation (SFF) on 22 March 2018. Subsequently, a copy of the Scoping Report was also sent to SFF for comment.

A full overview of all comments and feedback received during the informal stakeholder consultation and how these are addressed in the Environmental Statement (ES) is provided in Appendix 4. The stakeholder comments relating directly to impacts that are potentially significant are summarised below.

Comments referring to topics that should be scoped in or out of the impact assessment are presented in Table 6.1. A summary on how each comment has been addressed in this ES is also presented.

Table 6.1: Collated scoping comments relating to the assessment of potentially significant impacts

Scoping Comments	2026 Response Summary
OPRED	
Routine chemical use and discharge to sea during operation do not need to be assessed within the ES but they should be acknowledged and an overview of how this will be managed incorporated in the ES i.e. MAT/SATs.	The ES provides a high-level overview of chemical usage during the different stages of the project and indicates full details on chemical use and discharges will be provided in future PETS applications for these activities as part of the environmental permitting process (see Section 11).
With regard to produced water it is noted that the intention is to discharge overboard. SPE should note the OPRED expectation is for the re-injection produced water where practicable. Where not technically possible/desirable then a robust justification for not injecting must be provided.	Rationale for the decision to manage disposal of produced water through overboard discharge is included in the ES. Updated produced water dispersion modelling has been undertaken to reflect change in the project design, as presented in Sections 3, 4 and 11 of the ES.
In the event that there is overboard discharge of produced water SPE should note that OiW limit is likely to be less than 30 mg/l and the produced water treatment system should be designed to achieve as low a concentration as practicable in line with the principles of BAT.	
In order to support any conclusions on the impact of drilling discharges relevant modelling should be provided and any discharges of cement should be minimised and fully justified.	Updated drill cuttings modelling has been undertaken taking into account the updated well locations and to include recent OPRED requirement to include cuttings discharges from the potential well re-spuds and sidetracks, mirroring the Well Operations Notification System (WONS) consent (see Sections 4 and 10).
If well testing may be undertaken then this should be scoped in (no well testing is planned).	No well test operations are proposed (see Sections 3 and 4).
MODU, Infrastructure installation activities and FPSO combustion emissions should be scoped in.	Atmospheric emissions have been assessed and include Scope 3 emissions in line with recent guidance issued by OPRED (Section 9).
Any venting of unburned hydrocarbons should be scoped into the ES.	There will be no routine venting of unburnt hydrocarbons. Venting from cargo tanks will normally be recovered by the Vapour Recovery Unit (VRU) and routed to LP compression (Section 4). However, venting systems will be installed to safely manage non-routine operations such as process start-ups, upsets and emergencies.
Noise emissions from the FPSO and MODU should be considered. Where piling is required then this should also be scoped in. Similarly, if there is any seismic activity to be undertaken such as Vertical Seismic Profiling (VSP) then this should also be scoped in.	The potential impacts from underwater noise on receptors has been considered in the ES and assessed accordingly (Section 12).

Scoping Comments	2026 Response Summary
It is noted that the gas export pipeline is to be laid on the seabed with minimal rock dumping. The route and intended method of pipeline installation should be justified in the ES and the Department would emphasise that any rock deposits should be the minimum necessary to achieve the required protection/stability of the pipeline. The worst-case rock deposits should be discussed within the ES.	The revised project design means that rock placement is no longer required. A small number of concrete mattresses may be required at cable crossings. Impacts of the mattresses are considered in Section 8 of the ES.
The presence of the FPSO and production centres (referred to as Drill Centres in this ES) (and the temporary presence of MODU and support vessels) should be scoped in as per Section 3.2.6 and 3.4.3.4 of the EIA guidance. Where it is intended that there are additional 500 m safety zone around production centres, wellheads etc then these should also be scoped into the ES.	Details of all relevant infrastructure, FPSO and support vessels have been included in the ES (Section 4). Potential impacts from the presence of the FPSO, DCs, and safety zone have been considered in Section 8.
Both MODU and FPSO anchor impact need to be assessed, in addition to the disturbance impact of the other infrastructure. This should include the worst-case number of FPSO anchors.	A dynamically positioned Mobile Offshore Drilling Unit (MODU) and / or drill ship will be used to drill the wells at the proposed Cambo field development. Potential impacts from the FPSO anchors have been considered in the ES (See Sections 4 and 8).
Consideration should be given to cumulative effects e.g. potential impacts upon Faroe-Shetland Sponge-Belt NCMPA (3.2.12 [EIA Guidance]).	The gas export pipeline no longer traverses the Faroe-Shetland Sponge-Belt NCMPA. Potential impacts on this protected area are considered where relevant (i.e. Accidental Events - Section 14).
The risk and potential impact of failure of operational equipment or control systems, the precautions to prevent these occurring and a description of how these will be managed should be provided (3.2.6 and 3.2.10.2 [EIA Guidance]).	Preventative measures to reduce risk & potential impact of such failures are addressed under Accidental Events (Section 14).
A Major Environmental Incident (MEI) assessment will be required which incorporates the worst-case well blowout and total FPSO inventory as per Section 3.2.10 of the EIA guidance.	An MEI assessment has been provided in the ES (Section 14).
Section 4.4 of the Scoping Study states that the $250 million OPOL cover limit per incident is sufficient for most wells with only a small number of wells having the potential to exceed this. It is understood that none of the Cambo wells have the potential to exceed the OPOL limit but confirmation of this should be included.	Clean-up and 3rd party liability would be covered by the OPOL Limit (Section 14).
The ES will need to consider natural disasters (at a high level) as per Section of 3.2.10.2 of the EIA guidance.	Natural disasters are considered in the ES (Section 14).
Waste - while detailed information is not required, wastes and waste management should be described at a high level.	A section on waste and waste management is included in the ES (Section 13).
It is noted that there is no reference to decommissioning intentions. While there are no requirements to provide detailed information at the ES stage, higher level	Decommissioning is discussed at a high level in the Project Description (Section 4).

Scoping Comments	2026 Response Summary
considerations/design intentions should be addressed in line with Section 3.2.10.2 of the EIA guidance.	
Marine Directorate (formerly Marine Scotland)	
It is advised that cementing operations are detailed (Section 4) and associated environmental/ socio-economic impacts assessed in the ES.	Anticipated quantities of cement slurry, for a conventional well design, have been included in the ES and assessment accordingly (Section 10).
The detailed assessment of chemical usage will correctly be deferred to the chemical permitting stage, however, given that produced water is to be discharged from this development, and given the waxy nature of the crude (as highlighted in the scoping meeting on 23 March 2018) an upfront overview of any potential concerns from a chemical discharge perspective, is advised.	Chemical discharges are assessed in relation to drilling activities and acknowledged in relation to produced water discharge (See Sections 10 and 11).
Marine Scotland understand that the gas export pipeline is likely to be surface laid. Marine Scotland would expect justification in the ES as to the chosen pipeline installation method. It is advised that the installation method of other pipelines in the vicinity is also highlighted in support of the chosen method.	Pipeline installation methods are presented in the ES (Section 4).
It is understood that rock protection may be required for the pipeline and it is advised that the worst-case volumes and locations of protective material are included in the ES.	The revised project design means that rock placement is no longer required. A small number of concrete mattresses may be required at cable crossings. Impacts of the mattresses are considered in Section 8 of the ES.
It is advised that the local geo-morphological features are also considered when assessing any requirement for protective material and the potential for future free spanning of the pipeline is taken into account	The revised project design means that rock placement is no longer required. A small number of concrete mattresses may be required at cable crossings. Impacts of the mattresses are considered in Section 8 of the ES.
The use of long (2.5 km) polypropylene ropes in the mooring system of the Floating Production Storage and Offload (FPSO) vessel was discussed in the meeting on 23rd March 2018. Marine Scotland highlighted that due to lack of a metallic element, this rope can be evaded by sonar detection. Whilst fishing effort is not considered to be significant in this area, Marine Scotland would ask that this issue is discussed further with the SFF and that appropriate, proportionate mitigation is considered. Marine Scotland has been made aware in the past of transponders being fitted to each mooring line to allow fishing boats to detect the moorings	Polyester ropes are proposed for use in the mooring system instead of polypropylene. The design of the mooring system is not yet confirmed. Two different systems are being evaluated; either a reasonably large steel buoy attached 200 m below sea level, or a (metal) midline connector. Both of these would reflect sonar.

Scoping Comments	2026 Response Summary
It is recommended that the ES considers decommissioning upfront and details how all installed infrastructure/protective material would be removed should this be the policy in place at that time	Decommissioning is addressed at a high level in the Project Description (Section 4).
Joint Nature Conservation Committee (JNCC)	
Whilst JNCC appreciates that not all of the detailed project design will be finalised at the time of ES submission, JNCC notes that best practice would not be to submit subsequent applications where, for example, stabilisation / protection material requirements are incrementally increased. The worst-case scenario should be assessed in the ES to enable a meaningful assessment of the whole environmental impact of the project to be undertaken.	Worst-case scenarios are assessed throughout the ES (Sections 8 to 14). The revised project design means that rock placement is no longer required. A small number of concrete mattresses may be required at cable crossings. Impacts of the mattresses are considered in Section 8 of the ES.
The proposed Pipeline route from the Cambo Field Development is currently projected to interact with the Faroe Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA). The ES should contain relevant survey and feature sensitivity information which can be used to assess if the proposed operations are capable of affecting, other than insignificantly, the features for which the site is designated. Any conclusions should be clearly justified and audited within the ES. If the proposed operations are capable of affecting the designating features then the ES should contain an evidence based complete assessment, against the sites conservation objectives and provide details of any mitigation which will be used to minimise impact. The contribution of the Cambo Field Development to the anticipated cumulative impacts effecting the Faroe Shetland Sponge Belt NCMPA should also be considered. The impacts must be assessed across all relevant features of the site and consider all of the Conservation Objectives.	The revised project design means that the proposed Cambo export gas pipeline no longer transits through the Faroe-Shetland Sponge Belt NCMPA, thus greatly reducing the potential of any of the Cambo impacts causing a significant effect on this protected feature, as discussed in the appropriate impact sections (Sections 8, 10, 11 and 14). Where appropriate, the FeAST has been consulted as part of the impact assessment process for the Cambo field development.
West of Shetland is considered an area of importance for marine mammals. JNCC recommends that this is recognised within the ES and that impacts including, but not limited to noise, potential changes in food distribution are considered within the ES.	The importance of the area for marine mammals is recognised and acknowledged as such in the ES (see Sections 5, 12 and 14).
Scottish Fisheries Foundation (SFF)	
The SFF highlighted that there is a lot of fishing activity up and down the deepwater ridge [i.e. the edge of the continental shelf]. The load bearings of the pipe need to be able to tackle the 'hit' from any trawling/fishing gear. Pipeline protection needs to be considered.	The pipeline will be laid at water depths in excess of 1,000 m beyond the permitted limit for UK fishing vessels. Pipeline protection at these depths is not considered to be required.
SFF offered to present a fisheries awareness session to highlight the interactions between various fishing gear and oil industry infrastructure.	Ithaca Energy welcomes the opportunity for further engagement with the SFF regarding the project.

Scoping Comments	2026 Response Summary
The proposed surface laid pipelines (65 km and 59 Km) would be required to have sufficient loadings to interact with fishing methods that are deployed in the area.	The revised route for the gas export pipeline now transits northeast towards the planned Rosebank gas export pipeline and will be installed in water depths in excess of 1,000 m. At this depth there will be no interactions between the pipeline and UK fishing vessels which may be present in the area.

6.2 The ENVID Workshops

An ENVID workshop is a scoping exercise during which members of the project team identify all potential interactions of the proposed development with the environment and score their potential environmental impacts. A series of ENVID workshops were undertaken for the proposed Cambo field development, as reported in the two previous submissions of the Cambo ES. A new series of ENVID workshops was undertaken in 2025, to update and re-evaluate the previous ENVID outcomes to ensure all proposed changes in project design are adequately covered in the updated EIA. The 2025 ENVID workshops were attended by members of the project team from Ithaca Energy, as well as environmental consultants from Fugro.

During the ENVID workshops, all proposed development operations which may interact with the environment were identified during the workshop and divided into the following three categories:

- Drilling and completion operations;
- FPSO installation, commissioning and operation;
- Subsea infrastructure and pipeline installation and operation.

These activities are termed 'environmental aspects'. The source and pathway of each environmental aspect was defined, and all potential receptors that may be affected by that particular aspect were identified. The effects of each environmental aspect were then scored for each individual environmental aspect, using the minimum scoping thresholds outlined in Table 6.2 to determine whether their impact would require further detailed assessment and appropriate mitigation in the ES.

Table 6.2: ENVID workshop scoping matrix

Scoping thresholds for detailed assessment in the ES	To be scoped in
Detectable/measurable change to habitats and biological communities exceeding natural variability.	✓
An impact affecting any locally, nationally or internationally protected features.	
An environmental effect lasting more than a few days/weeks.	
An impact affecting behaviour or causing a nuisance to other users of the sea or the general public.	
An impact extending beyond the immediate footprint of the development.	
Impact is acknowledged to contribute to cumulative effects.	
Potential to cause risk to reputation of the company or commercial success.	
Noticeable change in landscape character causing changes to the view or other landscape characteristics.	
Usage of finite resources that may affect short-term availability and local market price.	

All aspects deemed to require further assessment and management measures to control them were scored as a 'Y' for 'Yes', are therefore 'scoped in' to be assessed further as part of the EIA process. Where a potential interaction was identified, but the associated impacts were deemed

to be insignificant, this was scored as 'N' for 'No'. Such interactions will not require further detailed assessment in the ES, i.e. these aspects are 'scoped out' of the EIA. The full results of the ENVID workshops undertaken are presented in Appendix 3.

6.2.1 The ENVID Workshop Findings

This section summarises the outcomes of the 2025 Cambo ENVID, by listing all activities that were identified as possibly having the potential to cause a significant impact and therefore will require further detailed assessment in the ES. The activities are categorised into their respective impact assessment sections in the ES. The complete ENVID matrix, together with the scores assigned to each aspect, is provided in Appendix 3.

Section 8 - Physical Presence:

Impacts on seabed communities and other users of the sea as a result of:

- Laying of the gas export line;
- Positioning of subsea infrastructure;
- Positioning of subsea infrastructure (anchors) relating to the FPSO;
- Temporary storage of FPSO anchor lines on the seabed for up to a year;
- Laying of concrete mattresses, grout bags etc for protection of flowlines or other infrastructure;
- Presence of MODU and support vessels; and
- Ongoing presence of the FPSO and subsea infrastructure, including anchors.

Section 9 - Atmospheric Emissions

Combustion emissions contributing to local air pollution and greenhouse gas (GHG) emissions, contributing cumulatively to global clime change as a result of:

- Fuel consumption by the MODU, installation vessels, FPSO, support vessels and helicopters;
- Flaring during commissioning and start-up;
- Combustion of hydrocarbons during non-routine flaring; and
- GHG emissions associated with the transportation, distribution and processing (refining) and end user combustion of hydrocarbons produced from the proposed Cambo field development (Scope 3, Category 9, 10 and 11 emissions).

Section 10 – Drilling Discharges

Impacts on seabed and water column communities due to discharges to sea including:

- Discharge of payzone cuttings;
- Discharge of drill cuttings, muds and associated chemical additives; and
- Discharge of cement.

Section 11 – Produced Water and Marine Discharges

Impacts on water column communities due to:

- Produced water discharges; and
- Discharge of ballast water.

Section 12 – Underwater Noise

Impacts on marine mammals and fish due to underwater noise as a result of:

- VSP survey on one of the drilled wells; and
- General operation of the MODU, FPSO and support vessels.

Section 14 – Accidental Events

Impacts on marine environment, the coastal environment, other users of the sea and loss of resource (e.g. steel) as a result of:

- A large, medium, or small spill of hydrocarbons; and
- Loss of the FPSO, installations vessels, support vessels, the MODU or a helicopter.

6.3 National Policies and Guidance

6.3.1 Scottish National Marine Plan Requirements

As discussed in Section 1.2.14, the Scottish NMP has established policies relating to potential impacts from oil and gas activity and these policies have been taken into full consideration during the EIA process. A summary of the general and oil and gas specific policies and objectives which are of relevance to the Cambo field development is presented below. All activities will be carried out using the principles of Best Available Technology (BAT) and Best Environmental Practice (BEP). Consideration will be given to key environmental risks including the impacts of underwater noise, oil and chemical contamination and habitat change.

These issues have all been considered as part of the 2025 (and the previous) Cambo ENVID workshops described in Section 6.2, and therefore already form part of the EIA. The NMP also requires operators to have adequate risk reduction measures and sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive. Furthermore, it requires that any future decommissioning operations will be undertaken in line with standard practice, and as allowed by international obligations.

The proposed Cambo field development has been assessed against the following general Marine Plan objectives and policies: GEN 1, 2, 3 ,4, 5, 6, 9, 10, 11, 12, 13, 14, 18, 19, 20 and 21.

6.3.1.1 GEN 1 – General Planning Principle

Development and use of the marine environment should be consistent with the Marine Plan, ensuring all activities are undertaken in a sustainable manner that protects and enhances Scotland's natural and historic marine environment. Ithaca Energy will ensure that any potential impacts associated with the proposed field development will be kept to a minimum as discussed in Section 8 to Section 14.

6.3.1.2 GEN 2 – Economic Benefit

The economic benefit of the development should be considered carefully and appropriately, as sustainable development and use of the marine environment can provide economic growth,

skill development, employment and opportunities for investment. The proposed Cambo field development will provide jobs and tax revenue to the Scottish economy.

6.3.1.3 GEN 3 – Social Benefit

Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of the NMP. The proposed field development is in line with sustainable development and considers other users of the sea and impacts upon them, as discussed in Section 5 and Section 8.

6.3.1.4 GEN 4 – Coexistence

Coexistence with other development sectors and activities is encouraged in planning and decision-making processes. Where conflict over space or resource exists or arises, marine planning should encourage initiatives between sectors to resolve conflict and take account of agreements where this is applicable. Ithaca Energy will ensure that any potential impacts on other sea users associated with the proposed Cambo field development will be kept to a minimum as discussed in Section 8.

6.3.1.5 GEN 5 – Climate Change

Marine planners and decision makers must act in a way best calculated to mitigate and adapt to climate change. Developers and users of the marine environment should seek to facilitate a transition to a low carbon economy through mitigation and adaptation and consider ways to reduce emissions of carbon and other greenhouse gasses. Ithaca Energy will ensure that any potential impacts associated with the proposed field development will be kept to a minimum, as discussed in Section 9.

6.3.1.6 GEN 6 – Historic Environment

Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance. There are no known wrecks or heritage sites within the development area, as discussed in Section 5.

6.3.1.7 GEN 9 – Natural Heritage

Development and use of the marine environment must:

- Comply with legal requirements for protected areas and protected species;
- Not result in significant impact on the national status of Priority Marine Features;
- Protect and, where appropriate, enhance the health of the marine area.

Ithaca Energy will ensure that any potential impacts to protected species and sites associated with the proposed field development operations will be kept to a minimum, as discussed in Section 8 and Section 10.

6.3.1.8 GEN 10 – Invasive Non-Native Species

Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made. All vessels and the MODU used during the proposed field development will follow International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 requirements.

6.3.1.9 GEN 11 – Marine Litter

Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Ithaca Energy and appointed Operators for the Cambo field development will ensure that any potential impacts associated with the proposed field development will be kept to a minimum as discussed in Section 13.

6.3.1.10 GEN 12 – Water Quality and Resource

Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply. Ithaca Energy and appointed Operators for the Cambo field development will ensure that any potential impacts to water quality associated with the proposed field development will be kept to a minimum as discussed in Section 10 and Section 11.

6.3.1.11 GEN 13 – Noise

Developments and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects. Ithaca Energy and appointed Operators for the Cambo field development will ensure that any potential impacts from noise associated with the proposed field development will be kept to a minimum as discussed in Section 12.

6.3.1.12 GEN 14 – Air Quality

Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits. Some development and use may result in increased emissions to air, including particulate matter and gasses. Impacts on relevant statutory air quality limits must be taken into account and mitigation measures adopted, if necessary, to allow an activity to proceed within these limits. Ithaca Energy and appointed Operators for the Cambo field development will ensure that any potential impacts to air quality associated with the proposed field development will be kept to a minimum as discussed in Section 9.

6.3.1.13 GEN 18 – Engagement

Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes. The proposed field development

has been subject to stakeholder engagement, as discussed in Section 6.1. The ES will be subject to public consultation.

6.3.1.14 GEN 19 – Sound Evidence

Decision making in the marine environment will be based on sound scientific and socio-economic evidence, drawn from a wide range of sources including the scientific community, stakeholders and users of the marine area. Ithaca Energy ensures the use of sound scientific and socio-economic evidence, as demonstrated throughout this ES.

6.3.1.15 GEN 20 – Adaptive Management

Adaptive management practices should be used to take account of new data and information in decision making. Ithaca Energy will ensure the continued use of the most up-to-date data and research when assessing the impact of the proposed field development, as demonstrated throughout this ES.

6.3.1.16 GEN 21 – Cumulative Impacts

Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation. Ithaca Energy and appointed Operators for the Cambo field development will ensure that any potential cumulative impacts associated with the proposed field development will be kept to a minimum as discussed in Section 8 to Section 14.

6.3.2 Oil and Gas Policies

In addition to the General Policies stated in Section 6.3.1, the Scottish NMP sets out six policies in relation to oil and gas developments in Scottish offshore waters. These are described in the following sections.

6.3.2.1 Oil & Gas 1

The Scottish Government proposes to work with the (historical) Department of Energy and Climate Change (DECC), the Oil and Gas Authority (OGA) and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that any environmental risks associated with these activities are regulated. Any activity should be undertaken in line with the principles of BAT and BEP. Consideration should be giving to key environmental risks including impacts from noise, oil and chemical contamination and habitat change. The ES considers each of these in dedicated impact sections where the level of significance of impacts is assessed and, where appropriate, mitigation to reduce or eliminate the impact is proposed.

6.3.2.2 Oil & Gas 2

If the re-use of oil and gas infrastructure is not feasible then decommissioning should take place in line with standard practice, and as allowed by international obligations. The re-use or removal of decommissioned assets from the seabed is encouraged where practicable and in accordance with relevant regulatory process. The Cambo gas export pipeline will tie-in to the

Rosebank gas export pipeline, thus optimising the uses of existing infrastructure in the area, as discussed in Sections 3 and 4 of the ES.

6.3.2.3 Oil & Gas 3

Where marine and coastal infrastructure is required for oil and gas developments, including for storage, any such development should utilise the minimum space required for the activity and take into account environmental and socio-economic constraints. Ithaca Energy has undertaken a concept select process (Section 3 of the ES) which considers environmental and socio-economic reasons for the proposed development. The physical footprint of the development in relation to other users of the sea is considered in Section 8 of the ES.

6.3.2.4 Oil & Gas 4

All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance.

6.3.2.5 Oil & Gas 5

Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions. The Cambo FPSO and its moorings will be designed taking into account potential future climate scenarios.

6.3.2.6 Oil & Gas 6

Consenting and licensing authorities must be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive. Section 14 of the ES assesses the impacts of accidental events and describes the emergency response and contingency strategies in place to manage such events appropriately in line with the National Contingency Plan and the Offshore Safety Directive.

6.3.3 Feature Activity Sensitivity Tool (FeAST)

The Marine Directorate FeAST has been developed to assist in investigating the sensitivity of marine features in Scotland's seas to potential impacts from human activities (FeAST, 2025). It is also used to determine potential management requirements for Nature Conservation Marine Protected Areas (NCMPAs) and Priority Marine Features (PMF). The Cambo field development is not within or in close proximity to a NCMPA (Section 5.6.2). However, Ithaca Energy recognises that certain PMFs may be present within, or make use, of the wider project area and as such, the FeAST has been reviewed when undertaking the EIA for the Cambo field development.

6.4 Concerns Identified for Further Assessment

The results from the ENVID workshop described in Section 6.2, the issues raised during the informal consultation process outlined in Section 6.1 and the national policies and guidance outlined in Section 6.3 together identified the potentially significant concerns associated with the proposed field development at the early planning stage. These concerns have driven the environmental considerations throughout the project and have helped guide mitigation measures incorporated into the project planning in order to eliminate or reduce the potential environmental impacts. Each concern that has been scoped in for further assessment is fully addressed in the subsequent sections of the ES.

The key concerns relating to the proposed Cambo field development are addressed under the following headings:

- Physical Presence (Section 8);
- Atmospheric Emissions (Section 9);
- Drilling Discharges (Section 10);
- Produced Water and Marine Discharges (Section 11);
- Underwater Noise (Section 12);
- Waste Management (Section 13);
- Accidental Events (Section 14).

In line with the requirements of the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020, any potential cumulative and transboundary impacts derived from this project have also been assessed, in the individual impact sections. Cumulative impacts are those from activities or events which individually may not be significant, but when combined with impacts arising from different sources that have an overlapping sphere of influence to the activities and events under consideration, may produce potentially significant impacts. Transboundary impacts comprise any potential environmental impacts on the seabed, water column and/or atmosphere, and which extent beyond the boundaries of the UKCS.

7. Impact Assessment Methodology

7.1 Introduction

The assessment methodology used in this Environmental Statement (ES) is based on a 'concerns based' approach, which means that the emphasis has been placed on assessing those environmental aspects (i.e. activities and processes) that have been identified during the scoping phase as potential key issues or concerns in Section 6. The methodology allows for a systematic, transparent and proportionate environmental impact assessment that is focused on those impacts that may potentially result in significant effects, if not managed and / or mitigated correctly.

The assessment methodology follows common legislative requirements and has drawn on a multitude of corporate, national, and international EIA guidance documents and best practice publications. Each potential concern is dealt with in the same manner, which involves outlining the concern, describing and quantifying the impacts and effects from the proposed activity, recognising any gaps in understanding and explaining how these are dealt with, and defining measures that have been taken to mitigate the impact.

The impact assessment methodology used in this Environmental Impact Assessment (EIA) follows a two stepped approach. The first step comprises a Source-Pathway Receptor (SPR) analysis to quantify each impact and establish the possible pathway(s) that it can affect one or multiple receptors and consequently result in an environmental effect on that/those given receptor(s).

During the second step of the assessment the indicated effects will be systematically assessed, based on their significance.

The terms 'Impact' and 'Effect' are frequently used interchangeably in many published documents. However, when following this assessment method, it is important to distinguish between these two terms.

'Impacts' are defined as measurable changes to the baseline environment conditions as a direct result of project activities (e.g. xx km^2 loss of habitat, or xx mg/l increase in a substance concentration).

Accordingly, 'Effects' are defined as the consequences of those impacts upon receptors of concern that are subject to assessments of significance. An environmental effect can be any change to the environment or its use. Effects can be positive (beneficial) or negative (adverse) and can result directly or indirectly from project activities or events. An overview of the Environmental Impact Methodology is provided in Figure 7.1 and is explained in more detail in the remainder of this Section.

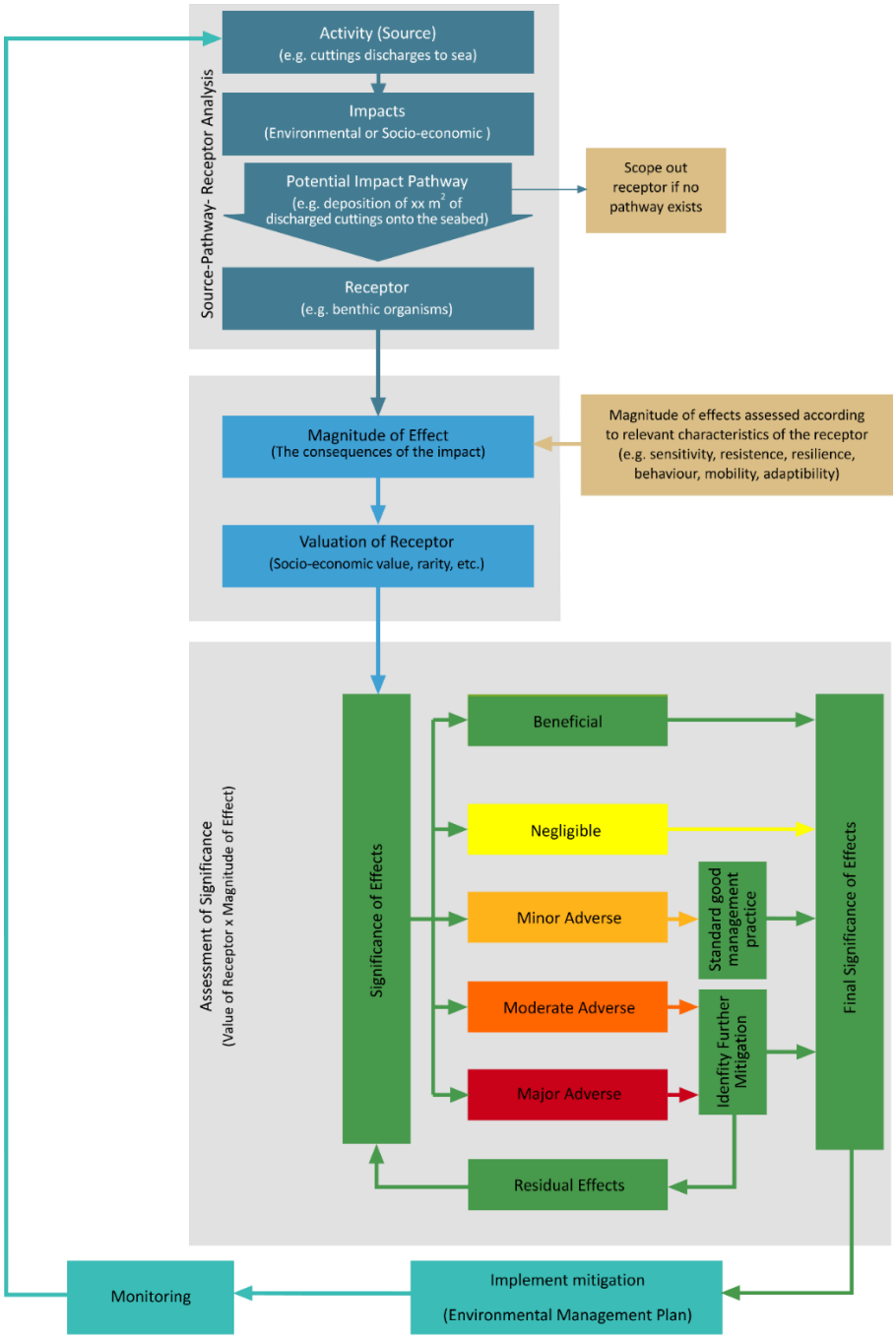


Figure 7.1: Environmental Impact Assessment methodology

7.2 Source-Pathway-Receptor Analysis

Determining which receptors may be affected by a specific activity relies on SPR analysis for the identification of the impact and consequential effects. SPR analysis considers all potential routes and mechanisms for impacts to affect all potential receptors along predicted pathways. The SPR analysis forms the first part of the assessment process, establishing and quantifying the impact(s) of a certain activity.

The term 'source' describes the origin of the impact (i.e. the operational activity resulting in an impact) e.g. the generation of drill cuttings onboard the mobile drilling unit (MODU).

Pathways are processes or series of interactions (i.e. the impacts) that result in an environmental effect upon a final receptor. Hence, the 'pathway' is the means (e.g. the discharge and subsequent deposition of xx m^2 of discharged cuttings onto the seabed) by which the source reaches the affected 'receptor' (e.g. benthic organisms). Pathways may be physical, chemical, ecological or socio-economic processes or interactions.

A receptor is a specific component of the baseline environment or socio-economic domain that will be, or is likely to be, affected by the impacts of the project. This could be a single entity such as a species or community, or a conceptual grouping such as a population or subset of an ecosystem. A receptor may be affected only by the proposed project, or by the proposed project and other relevant projects in combination. If no likely pathway can be demonstrated, then potential receptors can be scoped out, regardless of their intrinsic sensitivity or value.

7.3 Assessment of Effects and Their Significance

Once the impact pathway(s) has/have been established and subsequently quantified, the significance of each environmental effect is determined by combining the magnitude of the effect (Table 7.1) and the receptor value of the receptors (Table 7.2) using the significance matrix presented in Table 7.3. The outcomes are then reported in impact assessment sections of the ES, along with any mitigation measures identified during the EIA process. By using this predetermined scoring system, the reader can readily follow how the assessment conclusions are derived, ensuring a fully transparent and repeatable impact assessment process.

7.3.1 Characterising and Assessing the Magnitude of Effects

The magnitude of the potential environmental effects for each receptor is assessed using the same categories described in Table 7.1, taking into consideration the SPR analysis described in Section 7.2 above and the ecological sensitivity of the receptors being assessed, but independently of its value or designated status.

Ecological sensitivity is the relative change of a system or population in relation to the level of disturbance or perturbation (Miller et al., 2010). The sensitivity of socio-economic and socio-ecological systems may be defined in a similar manner (Holling, 2001).

The magnitude of ecological effects is the product of the project-specific impacts and the receptor specific characteristics that make those receptors sensitive or responsive to the relevant impacts. Therefore, when establishing the magnitude of effect value, the resilience of the affected receptor should be taken into account.

Although this approach works well for assessing most impacts, it cannot readily be applied to the assessment of greenhouse gases (GHG) emission impacts, as these contribute to cumulative global effects, rather than affecting a discrete localised area. In other words, there is no greater local climate change effect from a localised impact of GHG emission sources (or vice versa) (IEMA, 2022). Therefore, it is not possible to assess the global climate change effect of any individual project or development, directly. Instead, the EIA should provide context for the magnitude of GHG emissions to aid the evaluation of the significance of these effects, so

that the relative severity of the environmental effects can be weighed in the context of (national and international) planning balances developed to manage human-induced climate change. A project's carbon footprint can then be used to determine whether it supports or undermines a trajectory towards net zero. With regard to the Cambo field development, the context in this case refers to national and international climate change pathways, as outlined in Table 7.1.

Table 7.1: Magnitude of effect value and description

Magnitude of Effect and Value	Magnitude of Effect Description
Beneficial	a) A change that improves the quality of the environment e.g. by increasing species diversity, extending habitat or improving water quality. This may also include halting or slowing an existing decline in the quality of the environment. e) Improvements in the quality of life, economic opportunities, and social conditions for individuals, communities, or regions. i) A project that causes GHG emissions to be avoided or removed from the atmosphere by actively reversing (rather than only reduce) the risk of severe climate change.
Negligible	a) Minor change to an ecological system or population which is unlikely to be noticed or measurable against background variation. b) Receptor species or habitat is tolerant to high impact levels c) An environmental effect not likely to last more than a few days. d) Effects that are only detectable at source. e) No implications to other users of the sea or local communities. f) No risk to reputation of the company or commercial success. g) No discernible change in the existing view or other landscape characteristics. h) Usage of renewable or non-supply-limited resources with no measurable effect on current or future supply. i) A project that achieves emission mitigation that goes substantially beyond the national reduction trajectory, or substantially beyond existing and emerging national and international policies compatible with that trajectory, and has minimal residual emissions.
Minor	a) A detectable change to an ecological system or population which is within scope of existing variability. b) Receptor species or habitat is tolerant to moderate impact levels. c) A transient environmental effect not lasting more than a few weeks. d) Unlikely to contribute to cumulative effects. e) May affect behaviour, but not a nuisance to other users of the sea or general public. f) Transient issues regarding external relationships but with no long-term reputational consequences. g) Virtually imperceptible change in landscape receptors causing very minor changes to the view or other landscape characteristics over a wide area or minor changes over a limited area. h) Usage of finite resources with no measurable effect on current supply and not affecting market price. i) A project with GHG impacts that are fully consistent with applicable existing and emerging national and international policy requirements and good practice design standards for projects or developments of this type.
Moderate	a) Change in habitats and biological communities within the footprint of the development. b) Receptor species or habitat is tolerant to low impact levels.

Magnitude of Effect and Value	Magnitude of Effect Description
	c) Short-term change in habitats and biological communities with good recovery potential within 2 years. d) Similar scale of effect to existing variability but may have cumulative implications. e) May cause measurable nuisance to some other users of the sea or local communities. f) Risk of undermining reputation of the company within industry or with regulators. g) Moderate change in localised areas causing minor changes to the existing view or other landscape characteristics over a wide area or noticeable change over a limited area. h) Usage of finite resources that may affect short-term availability and local market price. i) A project with GHG impacts that are partially mitigated and may partially meet the applicable existing and emerging national and international policy requirements but is not fully compatible with the UK's net zero trajectory, or accepted aligned practice or area based transition targets, such as the revised OGA strategy.
Major	a) Change in habitats and biological communities extending beyond the immediate footprint of the development. b) Receptor species or habitat has little to no resilience to this type of impact c) Change in habitats and biological communities leading to medium term (> 2 years) damage, but with a likelihood of recovery within 10 years. d) Cumulative implications are understood to occur in relation to activities of this type. e) Financial loss or safety implications to other users of the sea or local communities. f) Undermining the reputation of the company with serious commercial implications. g) Notable change in landscape characteristics over an extensive area ranging to a very intensive change over a more limited area. h) Reduction in stock resource, affecting national availability and market price. i) A project that follows a 'business-as-usual' or 'do minimum' approach, which is only compliant with existing legislation and is not aligned the UK's and global climate change targets and objectives.
Severe	a) Wide scale change to the offshore environment or effects on coastal receptors. b) Receptor species or habitat is extremely sensitive to this impact, even at low exposure levels. c) Change in the natural environment, leading to long term (> 10 years) damage and poor potential for recovery to baseline conditions. d) Will make a significant contribution to national or global issues, individually or cumulatively. e) Long-term economic loss or strategic business changes for other users of the sea or local communities. f) Damage to company reputation of sufficient gravity, to incur irreparable damage to the business. g) Extensive long lasting (> 10 years) to permanent change in landscape characteristics over an extensive area. h) Reduction in stock resource, affecting global availability and market price. i) A project that locks in GHG emissions and does not contribute to any of the UK's and global climate change targets and objectives.
Notes Source: Fugro, 2025j.	

7.3.2 Valuation of Receptors

The next stage of the assessment is to determine the nature conservation, socio-economic or heritage value of the affected receptor, following the selected examples provided in Table 7.2.

It should be noted that the receptor value associated with the impact assessment of climate change impacts is treated differently compared to all other impacts assessed in the ES. The atmospheric concentration of GHGs (anthropogenic and otherwise) and resulting effect on climate change is affected by all carbon emission sources and sinks globally. Therefore, all GHG emission impacts and resulting effects are global, rather than affecting one localised area and the approach to cumulative effects assessment for GHGs differs from that used for the other EIA impacts (IEMA, 2022). In line with the guidance provided in the supplementary guidance for assessing the effects of downstream Scope 3 emissions on climate from offshore oil and gas projects (DESNZ, 2025) and the Institute of Environmental Management and Assessment (IEMA) guide: Assessing greenhouse gas emissions and evaluating their significance (IEMA, 2022), the receptor value for all cumulative GHG emissions is classed as being 'High' with regard to any further emissions. Hence, for all Cambo related emissions the receptor value is classed as 'High', as indicated in Table 7.2.

Table 7.2: Environmental and socio-economic receptor value

	Receptor Category	Selected Examples
Negligible	Natural environment (marine, coastal, terrestrial)	a) No sites or species of conservation interest. b) Not capable of supporting any threatened species or conservation interest. c) A poor habitat with low biodiversity and productivity.
	Other users	d) No commercially exploitable fisheries present. e) Areas of very low shipping intensity. f) Areas of no discernible anthropogenic use or socio-economic benefits.
	Landscape	g) Poor quality landscape, not representative of a wider type within the local area and capable of accommodating high levels of change/improvement/enhancement, with few or no views (visual amenity).
	Society	h) Renewable or non-supply-limited resource, readily available at point of use.
Low	Natural environment (marine, coastal, terrestrial)	a) No sites or species of conservation interest. b) No resident or regularly occurring threatened species or habitat present. c) A natural and diverse habitat supporting widespread and common species.
	Other users	d) Areas of low intensity fishing, not essential for supporting local communities. e) Areas of low shipping intensity. f) Areas of low intensity anthropogenic use.
	Landscape	g) Undesignated landscape of defined character type, but of low quality. Capable of tolerating moderate levels of change/improvement/enhancement. Views lack distinctive characteristics and/or are of low quality (visual amenity).
	Society	h) Reusable or recyclable resource, abundantly available on world market.

	Receptor Category	Selected Examples
Medium	Natural environment (marine, coastal, terrestrial)	a) Sites or species protected on a local level, or of acknowledged conservation value. b) The presence of a locally threatened species or habitat. c) Species and habitats of importance for the conservation of biodiversity at a local level.
	Other users	d) Areas used by local fisheries, but with nearby alternatives. e) Areas of moderate-high commercial shipping intensity. f) Multiple other stakeholder interest or extensive use for a single purpose.
	Landscape	g) Locally designated or recognised landscape with some distinctive character and features in reasonable condition. Capable of tolerating low levels of change without affecting key characteristics and elements (e.g. Local Green Space). Partial or interrupted views (visual amenity).
	Society	h) Non-reusable finite resource presently plentiful/abundantly available on world market.
High	Natural environment (marine, coastal, terrestrial)	a) Nationally designated site or protected species. b) A nationally threatened species or habitat essential for maintaining such species. c) Species and habitats of principal importance for the conservation of biodiversity at a national level.
	Other users	d) An area of regional importance for fisheries or of local importance but with no nearby alternatives. e) Major shipping activity located in a restricted area. f) Extensive use by multiple other industries.
	Landscape	g) Nationally designated or recognised landscape of high quality and distinctive character, with a strong sense of place, and susceptible to change which would permanently alter key characteristics and elements of the landscape (National Parks and Areas of Outstanding Natural Beauty (AONBs)). Partial or interrupted views (visual amenity).
	Society	h) Finite resource with restricted availability on the world market.
	Climate change	i) Any emission contributing to global climate change.
Very High	Natural environment (marine, coastal, terrestrial)	a) Internationally designated site or protected species. b) A regularly occurring, globally threatened species or habitat essential for maintaining such species. c) Species and habitats essential to conserve biodiversity at an international level.
	Other users	d) A major fishing area contributing at a national level. e) An internationally defined shipping lane. f) Any areas licensed for use by other industries.
	Landscape	g) Internationally designated or recognised landscape of exceptional quality and distinctive intact character with a large number of features and strong sense of place, and uninterrupted views (visual amenity).
	Society	h) Rare, finite and non-reusable resource only scarcely available on the world market.

Notes
During scoping, all atmospheric emissions were automatically scoped in for detailed assessed in the ES. The categories on climate change in this table are included to be used during the detailed impact assessment only, as explained in Section 7.3.
Source: Fugro, 2025j; IEMA, 2022.

7.3.3 Assessment of Significance of Effects

The significance of each effect is determined by scoring the value of the receptor against the magnitude of the predicted effect, as set out in Table 7.3. This methodology is applied individually with respect to the specific ecology, socio-economic or heritage characteristics of each receptor.

Table 7.3: Determining significance of adverse effects

		Nature Conservation Value, Socio-economic Value or Heritage and Cultural Value				
		Negligible	Low	Medium	High	Very High
Magnitude of Effect Value	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial
	Negligible	Negligible	Negligible	Negligible	Negligible	Minor adverse
	Minor	Negligible	Minor adverse	Minor adverse	Minor adverse	Minor adverse
	Moderate	Minor adverse	Minor adverse	Moderate adverse	Moderate adverse	Moderate adverse
	Major	Minor adverse	Moderate adverse	Moderate adverse	Major adverse	Major adverse
	Severe	Moderate adverse	Major adverse	Major adverse	Major adverse	Major adverse

Notes
Source: Fugro, 2025j.

The level of effect significance is used to determine the use and level of mitigation measures. Where a potential effect is assessed as 'Moderate adverse' or 'Major adverse', then this should be considered "significant" in EIA terms. So as far as practicable, mitigation measures (including offsetting) which reduce the potential magnitude or significance of effects, or the likelihood of significant effects, should be identified. 'Negligible' and 'Minor adverse' effects are considered 'Not Significant' in EIA terms and therefore generally do not require any additional action beyond standard good management practices. 'Beneficial' effects require no further assessment.

The outcome of the significance matrix (Table 7.3) determines the 'significance' of each impact that is assessed. Significance categories are defined in Table 7.4 and are generally consistent for all ES topics, with the exception of climate change impacts, which have their own dedicated effect categories, as indicated in the table.

Additional mitigation recommendations (see also Section 7.6 below) should be explored as part of the EIA process for 'Moderate adverse' or 'Major adverse' effects. Effects are reassessed as described above until either the effect significance is reduced to acceptable levels ('Minor adverse' or 'Negligible') or no more mitigation can be applied. Residual effect significance is then estimated, from which consenting decisions can be made.

Table 7.4: Effect significance categories

Category	Description of effects – general impacts	Description of effects – climate change
Beneficial	Effects that improve the baseline condition of the receptor. Positive change in social and economic conditions.	A project that causes GHG emissions to be avoided or removed from the atmosphere. Only projects that actively reverse (rather than only reduce) the risk of severe climate change can be judged as having a beneficial effect.
Negligible	An effect that is found to be not significant in the context of the stakeholder and/or regulator objectives, or legislative requirements.	A project that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory, and has minimal residual emissions. This project is playing a part in achieving the rate of transition required by (inter-)nationally set policy commitments.
Minor adverse	An effect considered sufficiently small (with or without mitigation) to be within accepted standards. No further action is required if it can be controlled by adopting normal good working practices.	A project with GHG impacts that are fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects or developments of this type. A project with 'Minor adverse' effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero
Moderate adverse	A significant effect that exceeds accepted limits and thresholds but is less serious than a 'Major adverse' effect. 'Moderate adverse' effects may include a reduction in the integrity or quality of a protected site or habitat, or a reduction in a local population of a protected species. Predicted 'Moderate adverse' effects require mitigation recommendations.	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with 'Moderate adverse' effects falls short of fully contributing to the UK's and global trajectories towards net zero.
Major adverse	A serious effect of the highest significance, where an acceptable limit or threshold is likely to be exceeded, that would result in a breach of statutory objectives or law. 'Major adverse' effects would include a major or permanent loss of a protected habitat or a local population of a protected species. Predicted 'Major adverse' effects require mitigation recommendations.	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with 'Major adverse' effects is locking in emissions and does not make a meaningful contribution to the UK's and global trajectories towards net zero.

Notes
Source: Fugro, 2025j; IEMA, 2022.

As explained in Section 7.3.2, the receptor value for global climate change impacts (in this case the atmospheric concentration of GHGs) is being classed as 'High' for all additional emissions, making all global cumulative GHG sources, regardless of size or location, relevant to the effects on climate change. Therefore, the only dynamic values for assessing climate change impacts are the magnitude of effect values described in Section 7.3.1. The magnitude of effect categories provide context, enabling the produced emissions to be evaluated against national and international planning balances. The project's carbon footprint can then be used to determine whether it supports or undermines a trajectory towards net zero.

The effect significance categories for climate change in Table 7.4 define significance depending on the project's whole life GHG emissions and how these align with the UK's and global net zero compatible trajectory. For the avoidance of doubt, in this instance a 'Minor adverse' or 'Negligible' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral (i.e. zero on balance), but refers to the likelihood of avoiding severe climate change, aligning project emissions with a science-based 1.5 °C compatible trajectory, limiting climate change to < 2 °C by 2100 and being in line with achieving the UK's net zero target by 2050. A project's impact can shift from a 'significant' moderate or major adverse effect to a 'non-significant' negligible or minor adverse effect by incorporating mitigation measures that substantially improve on business-as-usual and meet or exceed the science-based emissions trajectory of ongoing, but declining, emissions towards net zero (IEMA, 2022).

At the end of each impact section in the ES, a conclusion on the level of the significance of effects will be drawn, based on the methodology described in this section.

7.3.4 Frequency, Duration and Likelihood of Occurrence

Most impacts identified during scoping relate to planned activities, resulting in impacts and associated effects for which the frequency and duration of the activity and the scale and duration of the resulting effects can be readily predicted. However, for unplanned / accidental events the frequency, timing and duration and the scale and duration of any consequential effects may vary considerably. For example, some potential effects may be very improbable, but may be extremely serious should they occur, resulting in 'Major adverse' effects on some receptors. Therefore, as the final step of the assessment, it is also important to consider the likelihood that a potential effect could occur as predicted.

For unplanned / accidental events, where it may not be possible to reduce the magnitude of potential impacts or effects, the overall environmental risk may be decreased by reducing the likelihood of an adverse event occurring, through adequately designed-in mitigation measures (Gormley et al., 2011).

Hence, after assessing the initial potential worst-case effect, the overall residual environmental risk of any unplanned / accidental event will be determined by also taking into account the likelihood of that event happening, including all its preventive measures in place using the criteria listed in Table 7.5.

Table 7.5: Likelihood of an accidental event

Likelihood	Definition
Extremely Remote	The event has never occurred in the industry but is theoretically possible.
Remote	The event has occurred previously in the industry but is not anticipated to occur given current practices and mitigation procedures in place.
Unlikely	The event may occur during the lifetime of multiple, similar projects but is not expected to occur within the lifetime of one single project.
Possible	The event may occur during lifetime of the project.

Likelihood	Definition
Likely	The event is considered likely to occur at least once during lifetime of the project.
Certain	The activity / event is planned to occur.

The likelihood of the event should then be used to determine the acceptability of the effect significance score, based on the criteria outlined in Table 7.6 to determine whether an effect would be classified as 'Significant' or not.

Table 7.6: Determining final effect significance

		Effect Significance Categories			
		Negligible	Minor adverse	Moderate adverse	Major Adverse
Likelihood	Extremely Remote	Not Significant	Not Significant	Not Significant	Not Significant
	Remote	Not Significant	Not Significant	Not Significant	Not Significant
	Unlikely	Not Significant	Not Significant	Not Significant	Significant
	Possible	Not Significant	Not Significant	Significant	Significant
	Likely	Not Significant	Not Significant	Significant	Significant
	Certain	Not Significant	Not Significant	Significant	Significant

7.4 Assessing Multiple Options

The Cambo field development is currently in the Front End Engineering and Design (FEED) phase of the project life cycle, which means that not all project and engineering details are finalised at this point in time. Where multiple options and / or project solutions are still under consideration, each option / solution has been described in the project description of the ES (Section 4). In any instances where the predicted environmental impacts between two remaining options differ noticeably, the 'environmental worst-case option', i.e. the option or solution resulting in the largest anticipated environmental effect, will be assessed in the relevant impact assessment section(s) of the ES.

In the event that two options result in multiple impacts with contradictory 'worst-case' effects, then the activity resulting in that specific worst-case effect will be assessed independent of the results of its other impact(s). For example, Option 1 results in a large seabed footprint, but has low atmospheric emissions and Option 2 results in a small seabed footprint, but generates significantly more atmospheric emissions. In this case the ES will assess the seabed impacts from Option 1 and the atmospheric emissions from Option 2. This will ensure that the impact assessment in the ES always represents the 'environmental worst-case' impacts and effects associated with the proposed Cambo field development.

7.5 In-Combination, Cumulative and Transboundary Effects

In line with the requirements of the Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020, which replaces the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999, any potential cumulative, in-combination, and transboundary impacts

derived from this project have also been assessed, in the individual impact sections of the ES (Sections 8 to 14).

Cumulative impact effects can be described as the combined environmental effects of the proposed project or development with other past, present, or future projects and activities. These impacts can arise from the accumulation of individual, sometimes minor, effects from multiple actions that, together, may result in an overall significant effect.

An in-combination effect may occur when a single receptor is impacted by multiple impacts from a project. An example of this may be a benthic organism being impacted by the drilling and physical presence impacts. Cumulative effects may occur when the effects of a proposed project combine with others from other developments. An example here could be the discharge of cuttings from multiple projects undertaking drilling operations at a similar time.

Transboundary impacts comprise any potential environmental impacts on the seabed, water column and/or atmosphere, which extend beyond the boundaries of the United Kingdom Continental Shelf (UKCS).

7.6 Mitigation and Monitoring

The concept of mitigation is a central component of impact assessment and environmental management theory and practice and can be described as taking measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (IEMA, 2024).

The avoid, reduce, mitigate hierarchy (as presented by Department for Environment, Food and Rural Affairs (Defra) (2021)) was followed to minimise any impacts from the proposed development on the marine environment and other users. All impacts identified during the scoping phase were reviewed and fed back the project engineering team to identify and optimise the Front End Engineering and Design (FEED), as well as infrastructure installation methods.

Mitigation may include design changes, alteration of proposed methods, or other activities in addition to the core project-related activities, aiming to reduce or ameliorate impacts. Mitigation is often used as a catch-all term that also includes avoidance, minimisation, mitigation and offsets or compensatory measures.

Mitigation measures are predominantly applied at source, to reduce impacts, with the intention of a corresponding reduction in residual effects upon the receptors in question to acceptable levels. However, mitigation may also be applied directly at the receptor-level, with the intention of reducing effects, without any influence on the source or the impact.

Classifying mitigation measures into one of three key types helps to achieve a more proportionate Environmental Statement, as it allows for some mitigation measures to be taken-as-read in assessing effects (i.e. these mitigations are embedded intrinsically into the project

design as set out in the project description). IEMA has defined three mitigation categories (IEMA, 2024):

1. Primary (Inherent) mitigation;
2. Secondary (foreseeable) mitigation; and
3. Tertiary (inexorable) mitigation.

Primary mitigation is an inherent part of the project design and are actioned at the top of the mitigation hierarchy. They are best applied early, as they become more difficult to accommodate as the design progresses and stabilises. They become a fundamental part of the design seeking consent and are described in detail in the project description of the ES.

Secondary mitigation requires further activity in order to achieve the anticipated outcome. Typically, these will be described within the chapters of the Environmental Statement, but often they are secured through planning conditions, requirements and/or management plans. Secondary mitigation is a flexible form of mitigation that can be proposed at any point during the EIA process, including during the decision-making process. They tend to operate in the middle of the mitigation hierarchy, focusing on reducing the significance or likelihood of adverse effects. While they are integrated into the application for consent, this form of mitigation also requires additional action post-consent, beyond the core function of the development, to be implemented. Therefore, they carry a greater risk of non-implementation or ineffective application post-consent than primary or tertiary mitigation and are best managed through an Environmental Management Plan (EMP).

Tertiary mitigation measures will be required regardless of any EIA assessment and comprise actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects and therefore does not need to be presented in extensive detail in the EIA. However, it is good practise to mention them, so they be captured in the commitments register and subsequent EMP. Tertiary mitigation is the least flexible form of mitigation, it either exists, or it doesn't. It can be identified at any point during the design and EIA process. The EIA coordinator must be confident that any tertiary mitigation identified is very likely (> 90 %) to occur without further specific activity being undertaken within the EIA process.

Countries with a mature oil and gas industry and well-developed regulatory framework, such as the UK, have incorporated comprehensive mitigation and monitoring requirements within their permitting and consenting regime. These mitigation and monitoring measures are further informed and/or augmented with good industry practice guidance from organisations and institutions such as Oslo and Paris Convention (OSPAR), Offshore Energies UK and the International Association of Oil and Gas Producers (IOGP).

All mitigation and monitoring recommendations described within the ES are based upon the realistic worst-case scenarios, ensuring that all measures described are adequate to ameliorate the range of predicted effects. Mitigation and monitoring recommendations may be revised during the determination of application.

Ithaca Energy's management systems and that of third-party contractors (e.g. drilling contractor) will ensure all regulatory and industry standards are met, thus incorporating many inherent mitigation measures, as part of its "normal" operational procedures and practices. During the procurement process, all major third-party contractors will be audited to ensure they have suitable management systems in place.

Environmental mitigation and monitoring requirements are stated throughout the ES will be taken forward in an EMP. A Commitments Register, summarising these mitigation measures, has been included in Appendix 2.

8. Physical Presence

This Section assesses the potential impacts arising from the physical presence of the proposed Cambo field development infrastructure. This includes the impacts of associated drilling and construction activities, as defined in Section 4 (Project Description), upon benthic communities and other users of the sea. The scope of this assessment has been informed by the outcomes of the Environmental Issues Identification (ENVID) exercise (Appendix 3), informal statutory consultation and National Marine Plan policies and statutory guidance as explained in Section 6 (Identification of Impacts).

Potential impacts of the physical presence of the proposed Cambo field development assessed in this Section relate to the following aspects:

- Installation of the proposed gas export pipeline impacting on seabed communities;
- Positioning of subsea infrastructure within the infield area of the proposed development, including flowlines, manifolds, drill centres (DC), CAN-ductors and subsea distribution centre (SDC), impacting on seabed communities;
- Positioning of seabed infrastructure (anchors) relating to the Floating Production, Storage and Offloading Vessel (FPSO) impacting on seabed communities;
- Temporary storage of FPSO anchors on the seabed for up to a year impacting other users of the sea;
- Placement of concrete mattresses, grout bags, etc for protection of flowlines or other infrastructure impacting on seabed communities;
- Presence of MODU, support vessels, FPSO and associated anchor lines, as well as all other subsea infrastructure with a 500 m safety zone impacting on other users of the sea;
- Ongoing presence of subsea infrastructure, including anchors, on the seabed impacting seabed communities.

8.1 Impacts on Seabed and Associated Communities

8.1.1 Physical Extent of the Area Affected by the Proposed Operations

8.1.1.1 Proposed Export Gas Pipeline

A new 8" (20.32 cm) diameter Gas Export Pipeline (GEP) is proposed to be installed across 32.5 km of seabed between the proposed Cambo field development and a new tie-in structure connected to the Rosebank gas export system (subject to commercial negotiations) at the Rosebank in line tee (ILT).

The GEP will be surface laid on the seabed and, is set to cross two subsea cables, which will each be protected by 6 concrete mattresses. The GEP will have footprint on the seabed of 6,604 m^2 and the concrete mattresses will cover an additional 216 m^2 of seabed. The total footprint area of the GEP and the associated protective material will be 6,820 m^2.

The proposed Cambo GEP will have two pipeline end termination (PLET) structures at each end of the pipeline. Connection of the proposed GEP to the Rosebank gas export system will be

achieved through a gas export jumper between the Rosebank ILT and the Rosebank PLET. For the purposes of the Environmental Impact Assessment (EIA), the foundations of the two PLETs are assumed to be gravity based as a worst-case scenario in terms of seabed footprint. The PLETs will have a footprint on the seabed of 45 m^2 each (total 90 m^2), whilst the gas export jumper will cover 34 m^2.

Table 8.1 summarises the worst-case seabed footprint of the proposed Cambo GEP.

Table 8.1: Summary of the worst-case seabed footprint of the proposed GEP

Line Type	Installation Method	Length [m]	Width [m]	Total Area Affected [m^2]
GEP	Surface laid	32,500	0.2032	6,604
Concrete mattresses (×12)	Surface laid	6	3	216
PLETs (×2)	Gravity based	9	5	90
Gas export jumper	Surface laid	106	0.323	34
Total				**6,944**

8.1.1.2 Infield Infrastructure and Associated Risers, Umbilicals and Flowlines

Infield seabed infrastructure to be installed as part of the proposed Cambo field development will include wellheads for production wells, wellheads for water injection wells, subsea distribution centre (SDC), drill centre (DC) manifolds and a water injection (WI) manifold. Each riser and umbilical will be tethered to the seabed via tether-clamp anchors and hold-back clamp anchors.

There will be a total of 14 wellheads, one of which will be an optional appraisal well to confirm the optimal location for the two the production wells tying into DC 3. For assessment purposes, it is assumed that all wellheads will be installed using CAN-ductors (Section 4.4.2) which allows for the wellhead to be installed using gravity and suction. This technology removes the need for tophole drilling, conductor installation and cementing and thus avoids any associated discharges or accumulation of cuttings and excess cement on the adjacent seafloor. CAN-ductors create the largest footprint on the seabed (28.3 m^2 each), compared to a conventional wellhead, and thus represent the worst-case design in terms of seabed habitat take.

Three DC manifolds, one WI manifold, and one SDC will also be installed within the infield area. The manifolds are rectangular box shaped structures installed atop dedicated foundations structures. For the purposes of the current assessment, it is assumed that these foundation structures will be gravity-based, representing the largest potential seabed footprint.

Table 8.2 summarises the worst-case footprint of the infield seabed infrastructure.

Table 8.2: Summary of worst-case footprint of proposed infield infrastructure

Asset Type	Dimensions [m]	Footprint on Seabed [m^2]
Wellhead/CAN-ductor (×14)	6 (diameter)	396
DC1 Structure	17 × 13	221
DC2 Structure	15 × 13	195
DC3 Structure	15 × 13	195
Water Injection Manifold	16 × 10	160
SDC structure	14 × 10	140
Tether-clamp anchors (× 6)	6 (diameter)	170
Hold-back clamp anchors (× 2)	6 (diameter)	57
Hold-back clamp anchors (× 4)	4 (diameter)	50
Total		**1,584**

In addition, several new risers, umbilicals and flowlines will be installed on the seafloor to connect the wellheads, manifolds and other seabed infrastructure within the infield area of the proposed field development. Two umbilicals and an injection flowline are set to cross an existing subsea cable in the infield area. Each crossing will have 6 mattresses for protection, for a total of 18 mattresses. Table 8.3 summarises the overall worst-case footprint of the different types of in-field risers, umbilicals, flowlines and mattresses on the seabed.

Table 8.3: Summary of worst-case footprint of all in field umbilicals, risers and flowlines

Pipeline Type	Installation Method	Total Area Affected [m^2]
Production jumpers (× 9)	Surface laid	258
Gas lift jumpers (× 9)	Surface laid	63
Control umbilicals (× 20)	Surface laid	1,960
Production flowlines (× 6)	Surface laid	4,528
Gas lift flowline (× 3)	Surface laid	1,153
Injection flowline (× 6)	Surface laid	3,862
Gas export riser	Surface laid	173
Gas export jumper	Surface laid	65
Mattresses (× 18)	Surface laid	324
Total		**12,386**

8.1.1.3 Anchors and Anchor Lines

The FPSO will be anchored to the seafloor using suction anchor piles, each of which will have a footprint on the seabed of 44.2 m^2 (Section 4.6.3). Based on 18 suction anchor piles, the overall footprint of the FPSO mooring system will be 796 m^2.

Anchor lines will connect the FPSO to the anchor piles. These lines will comprise upper polyester ropes suspended in the water column and running down from the FPSO, which will be connected to the anchor piles at the seabed by a 150 m section of anchor chain. As a worst-

case estimate it is assumed that a maximum of 120 m of each anchor chain will raise and lower on the seafloor during extreme weather events, whilst 30 m of anchor chain from the anchor piles will remain static on the seabed at all times. Lateral movement of the anchor lines will be restricted to a maximum distance of 5 m on either side of each anchor chain at the furthest extent from the anchor piles. This would result in the periodic disturbance of 600 m^2 of seabed per anchor chain equating to an overall area of 10,800 m^2 for 18 anchor chains. Table 8.4 summarises the worst-case seabed footprint due to the presence of suction anchor piles and anchor chains.

Table 8.4: Worst-case footprint of suction anchor piles and anchor chains

Anchor Feature	Individual Pile or Line Footprint [m^2]	No. of Anchor Piles/Lines	Total Footprint [m^2]
Anchor suction pile	44.2	18	796
Anchor chain	600	18	10,800
Total			**11,596**

8.1.1.4 Temporary Seabed Obstructions

In addition to the permanent seabed structures, there will also be a number of obstructions placed on the seabed temporarily during the installation phase.

In the infield area, some of the subsea equipment may be temporarily located on the seabed in areas designated as laydown areas. These laydown areas will be approximately 4 m × 3 m (12 m^2). Up to 20 laydown areas may be required during installation operations.

Moreover, during the pipeline initiation phase, the GEP will be initially secured to the seabed by a temporary suction anchor pile, which will disturb 12.6 m^2 of seabed. Upon completion of the GEP installation operations, this suction anchor pile will be retrieved.

Prior to the FPSO arriving at the Cambo field for installation, the anchor chains, polyester mooring lines, and a suction anchor to secure the FPSO's submerged turret production (STP) buoy will be installed and laid on the seabed ('wet stored') leading to a temporary disturbance on the seabed lasting for up to 1 year.

Table 8.5 summarises the worst-case seabed footprint due to the temporary wet storage of the anchor chains, mooring lines, and STP buoy suction anchor on the seabed.

Table 8.5: Worst-case footprint of temporary seabed obstructions

Mooring Line Feature	Length [m]	Width [m]	Total Footprint [m^2]
Laydown areas (× 20)	4	3	240
GEP suction anchor pile	6	4 (diameter)	13
Polyester mooring line (×18)	2,100	0.27	10,206
Top anchor chain (×18)	150	0.68	1,836
Bottom anchor chain (×18)	150	0.68	1,836
STP buoy suction anchor	12	6 (diameter)	28
Total			**14,159**

8.1.1.5 Fibre Optic Cable

Provision has been made for a fibre optic cable (FOC) connecting the FPSO with the SHEFA-2 cable, which is located 23 km to the northwest of the Cambo FPSO. The FOC is approximately 23 mm wide and would be installed from the SDC within the Cambo field and then surface laid on the seabed until it connects with the SHEFA-2 cable. The cable is designed to be stable on the seabed without the need for additional protection. Table 8.6 summarises the worst-case seabed footprint due to the presence of the FOC.

Table 8.6: Worst-case footprint of FOC

Cable Feature	Cable Length [m]	Cable Width [m]	Total Footprint [m^2]
FOC	23,000	0.023	529
Total			**529**

8.1.2 Potential Effects on Seabed Communities

Potential effects of the physical presence of the proposed field development on seabed communities include seabed habitat take, habitat alteration, and seabed disturbances as summarised in Table 8.7 and assessed below.

Table 8.7: Summary of benthic effects

Impact	Relevant Development Area	Extent [m^2]	Extent [km^2]	Duration
Seabed habitat take	Installation of wellheads (CAN-ductors), DC manifolds, water injection manifold, SDC, risers, umbilicals and flowlines, FPSO anchor suction piles, PLET, and FOC	15,417	0.0154	Permanent (for duration of development)
	Surface laid GEP (including concrete mattresses)	6,820	0.0068	Permanent, depending on outcome of Comparative Assessment
Habitat alteration	Cable crossings concrete mattresses (GEP and infield)	540	0.0005	Permanent (for duration of development)
Seabed disturbance	Anchor chains	10,800	0.0108	Permanent (for duration of development)
	Temporary seabed obstructions (laydown areas, GEP suction anchor pile, wet-storage of anchor lines, chains, and STP suction anchor)	14,159	0.0141	Temporary

8.1.2.1 Seabed Habitat Take

The installation of the proposed subsea infrastructure on the seabed will result in a reduction in the total extent of the original seabed habitat available (i.e. 'seabed habitat take') over an area of up to 22,237 m^2 (0.02 km^2), by changing the original available habitat to an artificial substrate (see Table 8.7 above).

Seabed habitats that would be affected by the installation of this infrastructure include Arctic upper bathyal mixed sediment and rock, together with patches of bedrock outcrops, deep-sea muddy sand and 'offshore subtidal sands and gravels'.

Offshore subtidal sands and gravels are classed as a Priority Marine Feature (PMF) in Scotland) (Section 5.4.1) (Fugro, 2025a; MMT, 2018). However, it should be noted that 'offshore subtidal sands and gravels' PMF habitat is one of the most common and widely distributed habitats found in the UK offshore marine environment (Tyler-Walters et al., 2016).

Similarly, other seabed habitats found at the Cambo field development may be affected by the installation of infrastructure on the seabed. However, Arctic upper bathyal mixed sediment and rock together with deep-sea muddy sand habitats are not considered rare or representative of protected features but are instead widely distributed across the Faroe-Shetland Channel region as identified by seabed mapping (Section 5) and other studies (Bett, 2003; Jones et al., 2007; Jones et al., 2012).

Seabed video surveillance revealed the presence of low sponge coverage (5 % or less) and corals within the infield area and along the proposed GEP route (Fugro, 2025a; MMT, 2018). However, these features did not meet the qualifying criteria for the Oslo and Paris Commission (OSPAR) threatened and/or declining habitats 'Deep-sea sponge aggregation' or 'Coral gardens' and had low to no resemblance with the Annex I 'Reef' habitat. Moreover, Kazanidis et al. (2019) found that sponge assemblages within this area are generally constrained to a narrow depth band of between 450 m and 530 m, due to fisheries and other physical environmental factors. Consequently, as the proposed pipeline and installation of the in-field infrastructure will be carried out at depths of approximately 1,000 m, the Cambo field development is not forecast to affect significant sponge or coral assemblages.

The effects of seabed habitat take due to the installation of the proposed subsea infrastructure on the seabed will be long term, lasting for the duration of the proposed field development. However, once the Cambo field is decommissioned, all subsea infrastructure placed on the seabed will be removed again, after which habitats and associated communities will recover over time.

Recovery of the original seabed habitat will involve the infilling of any seabed depressions that have been left following the removal of seabed infrastructure and the return of the pre-construction seabed topography and stability. Some partial infilling of the depressions will take place through the slumping of the sides of the depressions as each item of infrastructure is withdrawn from the sediment, subject to the cohesiveness of the sediment, while subsequent infilling of remaining seabed depressions will be achieved by natural sedimentation and by any transient fine sediments within the regional bedload transport over time.

The timescale for habitat recovery is dependent on a number of factors including the cohesiveness of the affected sediment, the degree of local seabed mobility and the quantities of fine transient sediment available for infilling. Studies of seabed recovery following offshore wind farm construction, for example, show that seabed impacts from the placement of spud legs of construction vessels and from cable laying may take months to years to be infilled and that seabed habitats in lower energy environments may take a number of years to recover compared to those in higher energy and more mobile sediment areas (English et al., 2017). Given the deep-water location of the proposed field development, it is likely that the local environment is comparatively low energy suggesting seabed impacts from the installation of the proposed infrastructure may persist for a period of years following decommissioning.

Species will begin to re-colonise affected seabed areas as seabed topography and stability is gradually restored. Recolonisation will be achieved through the passive import and settlement of larvae and migration of adults and mobile benthos depending on the availability of local reproducing populations, local hydrodynamic conditions and the severity of the original impact and is expected to follow classic models of species succession (e.g. Newell et al., 1998; Pearson and Rosenberg, 1978). These typically involve an initial influx of small, short-lived and highly fecund species (opportunists) which are capable of tolerating disturbed conditions, but which are gradually replaced by larger, competitively superior species until an equilibrium

community, reflective of the prevailing habitat conditions, is achieved. Timescales for seabed communities to return to pre-installation conditions are not known at present due to the paucity of observations in equivalent deep-sea areas. However, studies in coastal shelf waters following the cessation of commercial aggregate dredging suggests that recovery of benthic community structure following physical impacts may require several years (Boyd et al., 2005; Cooper et al., 2007). Recovery of the local benthos at the proposed field development area following decommissioning may take several years (Cordes, 2016; Jones et al., 2012).

Due to the presence of the PMF feature 'offshore subtidal sands and gravel', the receptor value is considered to be '**High**'. However, 'offshore subtidal sands and gravel' PMF is one of the most common habitats found in UK offshore waters and it is not limited in its extent to the area of the Cambo field development. Moreover, the area of impact from the proposed subsea infrastructure on the seabed will be very small within the context of the wider habitat and will not affect any benthic species of conservation concern. Therefore, the magnitude of the effect is judged to be '**Minor**'. Consequently, effect significance is '**Minor adverse**'.

8.1.2.2 Habitat Alteration

The placement of concrete mattresses onto predominately sedimentary seabed areas will change the particle size distribution characteristics of ambient sediment habitat to a rocky and stony habitat. Concrete mattress placement will be limited to cable crossings of the proposed GEP and infield umbilicals and flowlines, which corresponds to a predominately mud, sand, and gravel seabed representative of 'offshore subtidal sands and gravels' PMF habitat. As a worst-case, concrete mattresses used would cover an area of up to 540 m^2 (0.00054 km^2) of this seabed type altering it to a rocky and stony habitat.

Seabed animals within the direct footprint of the concrete mattresses will be damaged, displaced or smothered resulting in the mortality and loss of individuals of species but the material itself could, over time, function as refugia for mobile epibenthos such as *Munida* sp. (squat lobster) or fish. HDR (2018) found fish and lobster apparently sheltering below concrete mattresses at an offshore wind farm in US whilst Redford et al., (2021) observed higher abundances of decapods and fish associated with concrete mattresses in the North Sea. The rate of colonisation of concrete mattresses will be dependent on recruitment rates from local reproducing populations but is expected to be slow due to the slow growth, low recruitment rates and late maturity of deep, cold-water assemblages (Cordes, 2016; Jones et al., 2012).

As the 'offshore subtidal sands and gravels' PMF habitat is observed in the area of the proposed field development, the receptor value is judged to be of '**High**' value. The habitat alteration caused by the placement of concrete mattresses along the GEP and in the infield area will be highly localised to the footprint of the installation. As discussed in Section 8.1.2.1, 'offshore subtidal sands and gravel' PMF is one of the most common habitats found in UK offshore waters and it is not limited in its extent to the area of the Cambo field development. Consequently, the magnitude of the effect is therefore judged to be '**Minor**'. The effect significance is '**Minor adverse**' and is not considered to be significant.

8.1.2.3 Seabed Disturbance

A small area of seabed in the infield area will be disturbed by the presence of the FPSO's anchor chains on the seabed. During extreme weather events some additional seabed disturbance may occur as a result of the raising and lowering of parts of the anchor chains agitating the seabed. This will result in long term but intermittent effects of seabed disturbance adjacent to each of the up to 18 FPSO suction anchor piles over a combined area of 0.01 km^2.

The temporary installation and subsequent removal of a 4 m diameter suction anchor pile during the GEP initiation phase will determine temporary seabed disturbance, as suction anchor piles are gravity-based infrastructure allowed to penetrate into the seabed. Although burrowing species which may be present at depth below the seabed surface could be affected, any effects caused by the GEP suction anchor pile will be highly localised over a very small area of 12.6 m^2 (1.26×10^{-5} km^2). Once the pile is removed after 27 days, following the completion of the GEP installation activities, the local seabed is expected to fully recover over time.

Within the infield area, up to 20 laydown areas each measuring approximately 4 m × 3 m may be established on the seabed during installation operations to temporarily locate subsea equipment prior to installation. The stored equipment within these areas is not expected to penetrate the seabed to any appreciable depth and is only likely to agitate the surficial sediment layers during any significant movement when the equipment is placed and subsequently removed from the seabed. Effects will be limited to an area of 240 m^2 (0.0002 km^2) and will only last for the duration of the installation operations.

Similarly, the 'wet storage' of the anchor chains, mooring lines, and STP buoy suction anchor are only superficially disturb the seabed and any effects will only last for up to 1 year and localised to 0.01 km^2 of the seabed.

Once installed, the anchor chains of the FPSO are also not expected to penetrate the seabed to any appreciable depth and only likely to agitate the surficial sediment layers during any significant movement of the mooring lines as a result of extreme weather events. Burrowing species which may be present at depth below the seabed surface are therefore not expected to be significantly affected although sessile epibenthic species attaching to and encrusting the seabed surface may be damaged or dislodged resulting in a reduced abundance and biomass of these populations locally.

Moreover, the PMF habitat 'offshore subtidal sands and gravels' was reported in the infield area of the Cambo field development. Whilst the GEP suction anchor pile, laydown areas, and the wet storage of anchor chains, mooring lines and STP buoy suction anchor will disturb up to 0.01 km^2 of this PMF temporarily, the movement of the anchor chains will result in an estimated seabed disturbance of 0.01 km^2 of the PMF for the life of the development.

The effects of seabed disturbance due to the action of the anchor chains will be intermittent, limited to extreme weather events, but will be permanent, lasting for the duration of the Cambo field development. The intermittent nature of the disturbance is expected to allow some partial

recovery of communities in affected areas during intervening periods between extreme weather events resulting in a reduced epifaunal community within the footprint of the anchor chains, compared to adjacent non-affected areas. Full recovery of the seabed within the influence of the movement of the anchor chains is anticipated following decommissioning.

Recovery characteristics of disturbed seabed sediments will be dependent on a number of factors including the nature of the seabed and the communities present, the severity of the original impact and the degree of disturbance already experienced at the site, i.e. from storm events or commercial fishing. BERR (2008) highlights that in general, recovery from seabed disturbances to a stable community in deeper waters could take many years. Deep-water sponges, which have been observed in the infield area of the proposed field development (Fugro, 2025a; MMT, 2018), are particularly slow growing and may require several years to recover from damage. The degree of existing disturbance, for example fishing, is an important factor in the consideration of benthic recovery from physical seabed impacts (BERR, 2008).

As the FPSO anchor chains moving during extreme weather events are expected to disturb the PMF habitat 'offshore sands and gravels', the value of the receptor is judged to be of '**High**' value. However, as noted previously, this PMF is one of the most common habitats found in UK offshore waters and is not limited to the area of the Cambo field development. Moreover, the spatial extent of the predicted seabed disturbance due to the movement of anchor chains and temporary placement of subsea equipment will be very small within the context of the wider habitat and will not affect any benthic species of conservation concern. Therefore, the magnitude of the effects is judged to be '**Minor**'. As a result, the significance of the effects is expected to be '**Minor adverse**'.

8.2 Impacts on Other Users of the Sea

8.2.1 Impacts on Commercial Fisheries

Under Regulation (EU) 2016/2336, bottom trawling in waters deeper than 800 m is prohibited in international waters of the Northeast Atlantic (Section 5.7.1) and so no displacement of demersal fishing vessels from the proposed Cambo FPSO site is forecast. Fishing effort by the over 10 m vessel class is low or none in this deep-water location (Section 5.7.1). The absence of significant fishing effort within and around the proposed FPSO site aligns with acoustic datasets (MMT, 2018) which shows that there are no trawl marks on the seabed within the proposed FPSO site area. Significant displacement of commercial fishing activities due to the installation and operation of the FPSO and MODU, temporary wet storage of anchor lines, temporary presence of other subsea obstructions, and physical presence of the proposed infield infrastructure with a 500 m safety zone is therefore not anticipated.

The presence of the pipeline laying vessel along the proposed GEP route may temporarily displace fishing from an imposed safety area of 500 m around the installation vessel although this will be short lived as pipe laying operations are scheduled for 27 days. In addition, the pipe laying vessel will be travelling along the proposed pipeline route during the installation period

and so fishing vessels will not be excluded from any one area during this time. No fishing vessels will be excluded from the area of the pipeline post installation.

Given the low level or absence of fisheries at and around the proposed FPSO site and the GEP, the receptor value is judged to be '**Low**'. The installation operations and the presence of infrastructure on the seabed for the life of the development will likely not affect fishing activities in the area, thus the magnitude of the effect is judged to be '**Minor**'. Therefore, the effect significance of the physical presence of the proposed field development is considered to be '**Minor adverse**', hence not significant.

8.2.2 Impacts on Shipping and Navigation

The installation of infrastructure associated with the proposed Cambo field development will require a number of construction and support vessels which could pose obstructions to local sea users during the installation phase. Sections 4.4 to 4.6 detail the numbers and types of vessels that are proposed to be used and presents a schedule for the installation activities. The current Construction vessels will be continuously present within the vicinity of the site between Q2 2028 and Q4 2030. Anchor chains and mooring lines will be wet stored for up to 1 year on the seabed prior to installation, which is currently estimated to be in Q2 2029. Once installed, the FPSO as well as all other subsea infrastructure with a 500 m safety zone will pose a permanent potential obstruction to other vessels in the area for the life of the field development.

As noted in Section 5.7.4, there is currently a very low level of shipping activity within the vicinity of the proposed Cambo field development. The infield area of the proposed field development will be crossed by the Rotterdam to Fuglafjordur shipping route, estimated to be used by one and one vessels per month (Anatec, 2025). Given the low numbers of other vessels, and open sea nature of the proposed development, then the effects of the presence of these infrastructure items and associated safety exclusions zones on shipping and navigation are considered minimal. Obstruction due to the presence of installation vessels will occur for a short period of time whilst the anchor chains and mooring lines are wet stored on location prior to installation and subsequently over a period of 72 days in Q2 2029 during installation of the anchor piles and mooring lines. Once these operations are complete, any obstruction due to the presence of installation vessels will be removed.

The ongoing presence of the Cambo FPSO will present a potential navigational risk for the duration of production operations (approximately 25 years). A guard vessel will be present, as required, and during construction activities whilst an Emergency Response and Rescue Vessel (ERRV) will remain onsite throughout the production phase of the field development to ensure that other sea users maintain a safe distance.

The pipeline laying vessel could also pose a short-term obstruction to shipping and navigation. However, the vessel will be moving continually along the proposed pipeline route during the 27 day installation period. Therefore, any obstruction will be of very short duration and long-term exclusion from any one area will not occur.

Given the very low volume of vessel traffic in the area of proposals, the value of the receptor is '**Negligible**'. Due the either the temporary nature or highly localised area of any obstruction, the magnitude of effects is '**Minor**'. Therefore, effect significance of the physical presence of the proposed field development on shipping and navigation are considered to be '**Negligible**' and thus not significant.

8.2.3 Impacts on Military Operations

No practice or exercise areas (PEXA) are located within the vicinity of the proposed field development and the Ministry of Defence (MoD) has previously been informed of the proposed operations and has confirmed that there are no safeguarding concerns. As such, there should be no impact on military activities.

8.3 Best Practice Measures

Safe working distances will be imposed during installation activities and 500 m safety zones will be put in place around infield infrastructure. This will ensure that other sea users are kept at a safe distance protected from any negative interactions. The FPSO and infield infrastructure 500 m safety zones will be enforced during operations by a dedicated Emergency Response and Rescue Vessel (ERRV).

All construction vessels will be highly visible and display the appropriate light or daytime signals to warn other sea users of the presence and their activities. When installed, the FPSO will also be highly visible and be in full compliance with the necessary Class and United Kingdom Continental Shelf (UKCS) legal requirements for identification, lighting and sound signals to alert all approaching vessels of its presence. Although the design of the FPSO mooring lines is not yet confirmed, consideration will be given to installing either a large steel buoy 200 m below sea level or a metal midline connector as sonar reflectors to allow fishing vessels to avoid entanglement with the FPSO.

A Vessel Traffic Study (VTS) was carried out in 2025 within the Cambo FPSO location (Block 204/10; Anatec, 2025). The VTS will be reviewed and, if required, updated prior to any application for a Consent to Locate, before drilling and installation operations commence.

Furthermore, to aid the safety of navigation, a Notice to Mariners will be posted prior to the wet storage of anchor lines on the seabed and to the FPSO and MODU moving onto location, ensuring that all vessels, including fishing vessels, will be aware of its presence in advance and for the duration of operations. In addition, Kingfisher will be notified of the exact location of the FPSO and MODU activities and the planned installation operations allowing inclusion in their fortnightly bulletin to fishing vessels. The UK Hydrographic Office (UKHO) will also be notified as to the location of the FPSO and the GEP so that these can be marked on navigational charts.

8.4 In-combination, Cumulative and Transboundary Impacts

The nearest existing surface infrastructure to the current proposals include the Glen Lyon FPSO at the Schiehallion field, located approximately 50 km to the south of the Cambo FPSO (NSTA, 2025d). Other surface infrastructure within the wider region includes the Aoka Mizu FPSO, located approximately 71 km south, at the Lancaster field which is currently being decommissioned. There are also three platforms at the Clair Ridge field located between 87 km and 89 km to the east of the proposed Cambo FPSO location. An FPSO is also planned at the Rosebank field located approximately 23 km to the northeast.

The Rotterdam to Fuglafjordur shipping route lies close to the proposed Cambo FPSO but only support a very low volume of vessel traffic (between 1 to 2 vessels per month). Similarly, fishing activity within and around the site of the FPSO and along the proposed GEP is very low or absent (Section 5.7.1), therefore, minimal interaction with commercial fishing is anticipated.

Given the distances of separation between the existing surface infrastructure at Schiehallion, Lancaster and Clair, the planned FPSO at Rosebank and the proposed Cambo FPSO, together with the low quantity of local vessel traffic and fishing activity locally, then any contribution to potential cumulative effects of physical presence impacts from the proposed field development on shipping, navigation and fisheries is likely to be insignificant.

Seabed infrastructure associated with other oil and gas infrastructure in the vicinity of the Cambo field development, such as the Schiehallion, Foinavon, Tormore, and Rosebank field developments, already occupy areas of benthic habitat within the wider region. The proposed field development will contribute to the overall habitat take but will only affect an area of up to 22,236.6 m^2 (0.022 km^2). Consequently, the contribution of the proposed Cambo field development to the cumulative habitat take is expected to be very small and not anticipated to significantly affect the overall benthic habitats characterising the region.

With respect to the physical presence of the proposed Cambo field development, no potentially significant in combination effects were identified which would justify further assessment, beyond the individual effects that have already been considered in this section, as this would not alter the conclusions reached.

The Cambo FPSO lies approximately 8 km from the UK/Faroe Island transboundary line at its nearest point. No potential for transboundary effects has been identified.

8.5 Conclusions

The overall predicted effects on seabed habitats and other users of the sea due to the temporary and permanent presence of infrastructure and vessels for the duration of the proposed Cambo field development are assessed to be '**Negligible'** to '**Minor adverse**'.

The proposed Cambo field development will be situated within an area of the PMF habitat 'offshore subtidal sands and gravels' resulting in benthic habitat take, habitat alteration, and seabed disturbance. The spatial extent of the predicted effects of the infrastructure installation

and operation will be very small within the context of the wider habitat, as it is widely distributed in UK waters. Effects of habitat take, habitat alteration, and seabed disturbance will last for the duration of the installation operations and for as long as the infrastructure remains in place. A Comparative Assessment will be undertaken to assess all potential decommissioning options available for the GEP at the time, including complete recovery of the pipeline as well as leaving sections of the pipeline in-situ. In conclusion, effects of the physical presence of the proposed field development on this feature will be long-term, but will be highly localised and will have no significant effects on the conservation of this PMF habitat.

The proposed location of the FPSO, infield infrastructure, and GEP is not associated with significant fishing or vessel traffic activity and so is highly unlikely to displace or interfere with these activities. Consideration will be given to installing reflectors on the mooring ropes of the FPSO to allow fishing vessels to avoid entanglement. A safety vessel will be available throughout the installation and operational phases of the Cambo field development to ensure other vessel users maintain a safe distance from the infrastructure. Some exclusion from fishing grounds around the immediate area of the pipelaying vessel may occur during pipe laying but this will be temporary lasting for the duration of the pipe laying operation, estimated to be 27 days. Also, the pipe laying vessel will be continuously moving along the pipeline route and so long-term obstruction and exclusion at any one location will not occur. Effects on fishing, shipping, and navigation due to the physical presence of the proposed field development are therefore considered to be not significant.

9. Atmospheric Emissions

This section addresses issues and concerns associated with atmospheric emissions, which were raised during the Environmental Issues Identification (ENVID), informal stakeholder consultation and those which are part of the National Marine Plan, namely:

- Contribution to air pollution and greenhouse gas (GHG) emissions as a result of fuel consumption by the Mobile Offshore Drilling Unit (MODU), installation vessels, Floating Production Storage and Offloading (FPSO), support vessels and helicopters;
- Contribution to air pollution and GHG emissions as a result of flaring during commissioning and start-up and combustion of hydrocarbons during non-routine flaring;
- GHG emissions associated with the transportation, distribution and processing (refining) and end user combustion of hydrocarbons produced from the proposed Cambo field development (Scope 3, Category 9, 10 and 11 emissions, as explained below);
- General Policies GEN 5: Climate Change and GEN 14: Air Quality of the National Marine Plan. GEN 5 stipulates that marine planners and decision makers must act in a way best calculated to mitigate and adapt to climate change and developers and users of the marine environment should seek to facilitate a transition to a low carbon economy through mitigation and adaptation and consider ways to reduce emissions of carbon and other greenhouse gasses. GEN 14 stipulates that development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.

The assessment will include all relevant 'Scope 1', 'Scope 2' and 'Scope 3' emissions, as defined in the 2015 revision of the Greenhouse Gas (GHG) Protocol (GHG Protocol, 2015) and interpretated in the DESNZ (2025) Environmental Impact Assessment (EIA) Scope 3 guidance as follows:

- Scope 1 GHG emissions are direct emissions from operations that are owned or controlled by the reporting company (i.e. in this case Ithaca Energy);
- Scope 2 emissions are indirect emissions from the generation of purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company; and
- Scope 3 GHG emissions are all indirect emissions (not included in Scope 2) that occur in the value chain.

The Scope 1 emissions associated with the proposed Cambo field development will take place onboard the FPSO where the processing of the produced hydrocarbons will take place throughout the life of field, including the processing of any fluids produced during commissioning activities, such as process start-up and during well clean-up operations and any associated flaring.

As all required electricity, steam, heating and cooling will be generated onboard the FPSO as part of the production process, there will be no Scope 2 emissions associated with the proposed Cambo field development, until such time that the FPSO can be supplied with

electricity from external renewable energy sources at some point in the future. As it is presently unknown when a renewable energy source may become available to be used by offshore installations situated West of Shetland, the impact assessment has been based on using fossil fuel sources instead, representing the worst-case scenario for the purposes of the impact assessment.

All emissions associated with the MODU, support and installation vessels and helicopters, as well as those generated during the transportation, distribution of the produced hydrocarbons and from their use by the end user are classed as Scope 3 emissions. Although none of these are owned by or under direct control of Ithaca Energy, they have been included for the purposes of the EIA in order to provide a complete and holistic assessment of the potential cumulative impacts that may result as a consequence of the proposed Cambo field development.

Scope 3 emissions comprise a wide range of upstream and downstream emission categories as listed in Table 9.1. For the purposes of this EIA, Scope 3 categories 4, 6, 9, 10 and 11 have been included in the assessment, as these are considered to cover the pertinent emissions with regard to the proposed Cambo field development. The upstream Scope 3 categories 4 and 6 cover the vessel and helicopter usage, whereas the downstream Scope 3 categories 9 and 10 cover the transportation, distribution and processing (refining) taking place before the produced hydrocarbons reach the end user. Downstream Scope 3, category 11 covers the emissions associated with the ultimate combustion of the sold hydrocarbons by the end users that will be produced over the life of the proposed Cambo field development. It is assumed that ultimately all sold hydrocarbons (i.e. 100 %) will be combusted.

Table 9.1: List of Scope 3 categories (adapted from GHG Protocol, 2011)

Upstream / Downstream	Scope 3 Categories
Upstream	1) Purchased goods and services
	Extraction, production, and transportation of goods and services purchased or acquired by the reporting company not otherwise included in Categories 2 – 8.
Upstream	2) Capital goods
	Extraction, production, and transportation of capital goods purchased or acquired by the reporting company.
Upstream	3) Fuel- and energy-related activities (not included in Scope 1 or Scope 2)
	Extraction, production, and transportation of capital goods purchased or acquired by the reporting company, including: a. Upstream emissions of purchased fuels (extraction, production, and transportation of fuels consumed by the reporting company); b. Upstream emissions of purchased electricity (extraction, production, and transportation of fuels consumed in the generation of electricity, steam, heating, and cooling consumed by the reporting company); c. Transmission and distribution (T&D) losses (generation of electricity, steam, heating and cooling that is consumed (i.e., lost) in a T&D system) – reported by end user;

Upstream / Downstream	Scope 3 Categories
	d. Generation of purchased electricity that is sold to end users (generation of electricity, steam, heating, and cooling that is purchased by the reporting company and sold to end users) - reported by utility company or energy retailer only.
Upstream	4) Upstream transportation and distribution ■ Transportation and distribution of products purchased by the reporting company between a company's tier 1 suppliers and its own operations (in vehicles and facilities not owned or controlled by the reporting company); ■ Transportation and distribution services purchased by the reporting company, including inbound logistics, outbound logistics (e.g., of sold products), and transportation and distribution between a company's own facilities (in vehicles and facilities not owned or controlled by the reporting company).
Upstream	5) Waste generated in operations Disposal and treatment of waste generated in the reporting company's operations (in facilities not owned or controlled by the reporting company).
Upstream	6) Business travel Transportation of employees for business-related activities (in vehicles not owned or operated by the reporting company).
Upstream	7) Employee commuting Transportation of employees between their homes and their worksites (in vehicles not owned or operated by the reporting company).
Upstream	8) Upstream leased assets Operation of assets leased by the reporting company (lessee) and not included in Scope 1 and Scope 2 – reported by lessee.
Downstream	9) Downstream transportation and distribution Transportation and distribution of products sold by the reporting company between the reporting company's operations and the end consumer (if not paid for by the reporting company), including retail and storage (in vehicles and facilities not owned or controlled by the reporting company).
Downstream	10) Processing of sold products Processing of intermediate products sold by downstream companies (e.g. refineries).
Downstream	11) Use of sold products End use of goods and services sold by the reporting company. The direct use-phase emissions of sold products over their expected lifetime (i.e., the Scope 1 and Scope 2 emissions of end users that occur from the use of: products that directly consume energy (fuels or electricity) during use; fuels and feedstocks; and GHGs and products that contain or form GHGs that are emitted during use.
Downstream	12) End-of-life treatment of sold products Waste disposal and treatment of products sold by the reporting company at the end of their life.
Downstream	13) Downstream leased assets Operation of assets owned by the reporting company (lessor) and leased to other entities, not included in Scope 1 and Scope 2 – reported by lessor.
Downstream	14) Franchises Operation of franchises, not included in Scope 1 and Scope 2 – reported by franchisor.

Upstream / Downstream	Scope 3 Categories
Downstream	15) Investments
	Operation of investments (including equity and debt investments and project finance), not included in Scope 1 or Scope 2.

During the drilling, installation and operation of the proposed Cambo field development, atmospheric emissions will be generated by releasing carbon dioxide (CO_2), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and volatile organic compounds (VOCs) into the atmosphere. The emissions produced during these operations are known to contribute to a number of environmental processes and impacts, including global warming, acidification (acid rain), the formation of low-level ozone layer (also referred to as tropospheric ozone), and local air pollution (Lee et al., 202).

The most commonly used general indicator for global climate change is the global warming potential (GWP), expressed in tonnes of CO_2 equivalents. All gaseous substances that contribute towards global warming (referred to as 'greenhouse gases') have a GWP factor that allows the conversion of individual emissions into CO_2 equivalents. As such, GWP can be used to estimate the potential future impacts of gaseous emissions upon the climate system.

GWP is a measure of the relative radiative effect of a given gas compared to that of CO_2, integrated over a chosen time horizon (often a 100-year time period). Simply stated, the GWP of a specific gas is a measure of its climate change impact relative to carbon dioxide (AEA, 2007).

Greenhouse gases can be divided into 'direct' and 'indirect' greenhouse gases[1]. Direct greenhouse gases contribute directly to climate change owing to their positive radiative forcing effect, as described above. The GHG protocol recognises six direct greenhouse gases that are reported under the United Nations Framework Convention on Climate Change (UNFCCC), namely CO_2, CH_4 (methane) and N_2O (nitrous oxide) and the so-called 'F-gasses' comprising hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6). With regard to the proposed Cambo field development, only the first three of these direct greenhouse gases (CO_2, CH_4 and N_2O) are relevant to the combustion emissions assessed here.

Indirect greenhouse gases, like carbon monoxide (CO) and NO_x, do not trap heat themselves but can react in the atmosphere to form warming gases, such as tropospheric ozone. They can also affect the concentration of hydroxyl (OH) radicals, which are crucial for breaking down other greenhouse gases like CH_4. Their role in climate change is complex because they also have a strong impact on air quality and can lead to cooling effects in certain parts of the atmosphere.

[1] Please note that the terms '**direct**' and '**indirect**' in the context of **greenhouse gases**, as described here have a different meaning than when used in the context of **Scope 1 ,2 and 3 emissions**, where they refer to whether the emissions are under direct control of the reporting company (i.e. in this case Ithaca Energy) or not.

Other combustion emissions, such as SO_2 and small particulate matter (PM) do not contribute to climate change, but do contribute to local and regional air pollution.

Table 9.2 summarises the GWP factor of each of the combustion gases associated with the proposed Cambo field development, as well as their 100-year GWP factor. The GWP factors of the direct greenhouse are used for the emission calculations in the remainder of this section, as per the GHG protocol.

Table 9.2: Environmental effects and GWP of atmospheric emissions

Gaseous emission	Environmental Effect	100-Year GWP Factor*
Direct Greenhouse Gases		
Carbon dioxide (CO_2)	Direct greenhouse gas contributing to climate change, meaning that it inhibits the radiation of heat into space, increasing temperatures at the Earth's surface.	1
Methane (CH_4)	Direct greenhouse gas contributing to climate change.	25
Nitrous oxide (N_2O)	Direct greenhouse gas contributing to climate change.	298
Indirect Greenhouse Gases		
Carbon monoxide (CO)	Direct effects upon human health (asphyxiant). May contribute indirectly to climate change.	East Asia: 1.8 (±0.6) [a] EU + North Africa: 1.6 (±0.5) [a] North America: 1.8 (±0.6) [a] South Asia: 1.8 (±0.6) [a] Global: 2 to 3.3[b] Global: 2.2 (±0.6)[c] Global: 3.3 (±0.8)[c] Global: 5.3 (±2.3)[c]
Oxides of nitrogen (NO_x)	Nitrogen dioxide (NO_2) has direct effects upon human health and vegetation and has the potential to cause respiratory illness and irritation of the mucous membranes. NO_x acts as a precursor to low-level ozone formation. While short-lived, ozone is a very potent greenhouse gas that can contribute significantly to climate warming and is a major component of smog, affecting air quality and human health. NO_x contributes to acid deposition (wet and dry) which impacts both freshwater and terrestrial ecosystems.	East Asia: -5.3 (±11.5) [a] EU + North Africa: -15.6 (±5.8) [a] North America: -8.2 (±10.3) [a] South Asia: -25.3 (±29.0) [a] Mid-latitude: -18 to +1.6 [b] Tropical: -28 to -10 [b] Global: -11[d] Global: -31 (±10)[c] Global: -95 (±31)[c] Global: -159 (±79)[c]
Volatile organic compounds (VOC)	VOCs include non-methane hydrocarbons (NMHC) and oxygenated NMHC (e.g. alcohols, aldehydes and organic acids), have short atmospheric lifetimes (fractions of a day to months) and small direct impact on radiative forcing. VOC influence climate through their production of organic aerosols and their involvement in photochemistry, i.e. production of ozone (O_3) in the presence of NO_x and light. Generally, fossil VOC sources	East Asia: 5.0 (±2.1) [e] EU + North Africa: 5.6 (±2.8) [e] North America: 5.0 (±3.0) [e] South Asia: 8.8 (±1.9) [e] Global: 4.5[f]

Gaseous emission	Environmental Effect	100-Year GWP Factor*
	have already been accounted for as the release of fossil C in the CO_2 budgets and therefore are not counted as a source of CO_2.	
Other		
Sulphur dioxide (SO_2)	SO_2 has direct health effects - causes respiratory illness. SO_2 contributes to acid deposition (wet and dry) which impacts both freshwater and terrestrial ecosystems.	-
Particulate matter (PM)	The environmental effect of particulate matter is mainly determined by the size (and shape) of the particles. Particles emitted from modern diesel engines (commonly referred to as Diesel Particulate Matter, or DPM) are typically in the size range of 100 nanometres (0.1 µm) and can penetrate the deepest part of the lungs. In addition, these soot particles also carry carcinogenic components. In high concentrations particulate matter can also affect plant growth.	-

Notes:
* = GWPs are from Myhre et al (2013) and refer to the 100-year horizon values.

Sources referred to in Myhre et al (2013):
a: Fry et al. (2012) (updated by including stratospheric H_2O) and Collins et al. (2013)
b: Fuglestvedt et al. (2010), with the VOC values based on Collins et al. (2002).
c: Shindell et al. (2009). Three values are given: First, without aerosols, second, direct aerosol effect included, third, direct and indirect aerosol effects included. Uncertainty ranges from Shindell et al. (2009) are given for 95 % confidence levels.
d: Fuglestvedt et al. (2010); based on Wild et al. (2001).
e: Fry et al. (2012) (updated by including stratospheric H_2O) and Collins et al. (2013).
f: Fuglestvedt et al. (2010) based on Collins et al. (2002).

9.1 Quantification of Atmospheric Emissions

Atmospheric emissions contribute to a variety of environmental effects and associated impacts, including local air pollution and climate change.

9.1.1 Data Sources and Uncertainty

As all operations associated with the proposed Cambo field development will take place in the future, there are currently no direct monitoring data available to inform this assessment. Therefore, the quantification of emissions in this Section of the ES are based on generic emission factors from sectoral guidelines and other relevant literature, as indicated and referenced throughout this section. Where available, representative proxies have been used, as appropriate.

The calculations are based on the fuel consumption estimates presented in Section 4 (Project Description).

The quantification of emissions in this Section of the ES is mainly based on generic emission factors and should be used as an indication of the order of magnitude only. The calculations

are based on the fuel consumption estimates presented in Section 4 (Project Description), namely from Tables 4.4 worst-case scenario for the drilling operation, Table 4.14 for the SPS SURF Installation, Table 4.16 for FPSO installation and the fuel consumption of the FPSO during the production phase, as discussed in Section 4.6.12.

9.1.2 Quantification of Drilling Emissions

It is estimated that the MODU will consume up to 44 tonnes of diesel per day, based on general industry figures for MODUs and drillships capable of working West of Shetland. With a total operational time of up to 1,214 days to drill and complete all 13 wells, this will amount to approximately 53,416 tonnes of diesel being used for power generation during drilling and completion operations.

In addition to the fuel used by the MODU itself, all support vessels (supply vessels, standby vessel and helicopter) will also consume fuel and produce exhaust emissions. Table 9.3 provides the predicted emissions from these sources, based on their total fuel consumption.

Table 9.3: Estimated emissions during drilling and well completion

		MODU	Supply Vessel	Standby Vessel	CSV	Helicopter Flights	Total
Consumption (tonnes)		53,416	6,940	7,284	990	607	69,237
Emissions	CO_2 (tonnes)	170,931	22,208	23,309	3,168	1,942	221,558
	CO (tonnes)	838.6	55.5	58.3	7.9	3.2	963
	NO_x (tonnes)	3,172.9	409.5	429.8	58.4	7.6	4,078
	N_2O (tonnes)	11.75	1.53	1.60	0.22	0.13	15
	SO_2 (tonnes)	213.7	69.4	72.8	9.9	1.0	367
	CH_4 (tonnes)	9.61	1.87	1.97	0.27	0.05	14
	VOC (tonnes)	106.83	16.66	17.48	2.38	0.49	144
	GWP (tCO_2e)	**173,808**	**22,747**	**23,875**	**3,245**	**1,960**	**225,635**

Notes
CSV = Construction Support Vessel
MODU = Mobile Offshore Drilling Unit

9.1.3 Quantification of Emissions during the Installation of SPS/SURF, FPSO and Pipeline

The emissions and resulting GWPs associated with the installation of the Subsea Production System/Subsea Umbilicals, Risers, and Flowlines (SPS/SURF), the FPSO and the gas export pipeline (GEP) are presented in Table 9.4.

Table 9.4: Estimated emissions during subsea installation

		DP CSV / HLV	Anchor Handling Vessel	Utility / Survey Vessel	Reel Lay Vessel	Total
Consumption (tonnes)		5,082	992	2,366	459	8,899
Emissions	CO_2 (tonnes)	16,262	3,174	7,571	1,469	28,477
	CO (tonnes)	40.7	7.9	18.9	3.7	71
	NO_x (tonnes)	299.8	58.5	139.6	27.1	525
	N_2O (tonnes)	1.12	0.22	0.52	0.10	2
	SO_2 (tonnes)	50.8	9.9	23.7	4.6	89
	CH_4 (tonnes)	1.37	0.27	0.64	0.12	2
	VOC (tonnes)	12.20	2.38	5.68	1.10	21
	GWP (tCO_2e)	**16,657**	**3,251**	**7,755**	**1,504**	**29,168**

Notes
DP = Dynamic Positioning
CSV = Construction Support Vessel
HLV = Heavy Lift Vessel

9.1.4 Quantification of Emissions from Well clean-up and Commissioning flaring

After drilling and completing the wells, they will be left suspended so they can be cleaned up once the FPSO is installed, so that most of the hydrocarbons extracted from the produced fluids during clean-up can be separated out and exported or used as fuel gas, with only a small fraction being flared off through the flare system. Assuming up to 36 hrs clean-up per well, cleaning up all 9 production wells will take up to 13.5 days in total.

In addition, flaring will take place when starting up the production process. Based on the size and complexity of the proposed Cambo field development, it is estimated that up to 424,752.7 Sm^3 (15 MMscf/day) will be flared off over a period of 30 to 90 days.

Table 9.5 summarises the GHG emissions generated during well clean-up and commissioning flaring. As the Mid-case shows the highest gas flow rates at start-up, this rate has been used to represent the worst-case scenario for the purposes of this impact assessment.

Table 9.5: Estimated emissions during commissioning (mid-case)

	Well clean-up flaring (13.5 days)	Commissioning flaring (90 days)	Total
Consumption (tonnes)	466.5	45,946	51,754
GWP (tCO_2e)	**1,296**	**129,020**	**147,410**

Furthermore, up to 5,301 tonnes of diesel will be consumed to generate inert gas. Inert gas is used to pressurise empty pipelines, vessels, etc, to expel any air in them, to prevent the potential build-up of flammable/explosive gas mixtures during commissioning. These diesel emissions are included in Table 9.6 below, as part of the overall FPSO (Scope 1) emissions.

9.1.5 Quantification of Emissions During Operations / Production

During production, the Cambo FPSO is expected to produce emissions via the combustion of produced gas and diesel as fuel, and via the flaring of produced gas during transient, non-routine conditions. All emissions calculations are based on 60 days of production in 2030 (when production is expected to commence), followed by 365/366 days of production in subsequent years. Table 9.6 presents the estimated emissions and GWP generated by the FPSO for the high, mid and low production scenarios, over the life of the field. These are the Scope 1 emissions and form the largest part of the upstream emissions. For completeness, the ERRV, supply vessel (Scope 3, category 4) and helicopter (Scope 3, Category 6) emissions are also included in these totals.

Table 9.6: Estimated upstream production emissions over the life of field (Scope 1 and Scope 3, Categories 4 and 6)

Year	GWP for low-case (kton CO_2e)			GWP mid-case (kton CO_2e)			GWP high-case (kton CO_2e)		
	FPSO	ERRV, Supply Vessel, Heli-copter	Total	FPSO	ERRV, Supply Vessel, Heli-copter	Total	FPSO	ERRV, Supply Vessel, Heli-copter	Total
2030	83.0	8.0	91.0	109.5	8.0	117.5	101.1	8.0	109.1
2031	160.2	11.8	172.0	167.5	11.8	179.3	162.3	11.8	174.1
2032	137.8	11.8	149.6	141.0	11.8	152.8	140.0	11.8	151.8
2033	130.4	11.8	142.2	139.1	11.8	150.9	139.8	11.8	151.6
2034	121.3	11.8	133.1	135.6	11.8	147.4	137.0	11.8	148.8
2035	116.9	11.8	128.7	129.1	11.8	140.9	135.6	11.8	147.4
2036	114.1	11.8	125.9	122.5	11.8	134.3	131.0	11.8	142.8
2037	111.7	11.8	123.5	118.0	11.8	129.8	125.4	11.8	137.2
2038	110.4	11.8	122.2	115.1	11.8	126.9	121.2	11.8	133.0
2039	109.3	11.8	121.1	112.2	11.8	124.0	118.5	11.8	130.3
2040	108.8	11.8	120.6	110.5	11.8	122.3	116.9	11.8	128.7
2041	107.9	11.8	119.7	109.3	11.8	121.1	115.0	11.8	126.8
2042	107.3	11.8	119.1	108.7	11.8	120.5	113.5	11.8	125.3
2043	106.8	11.8	118.6	108.2	11.8	120.0	112.1	11.8	123.9
2044	106.6	11.8	118.4	108.1	11.8	119.9	111.1	11.8	122.9
2045	106.0	11.8	117.8	107.5	11.8	119.3	109.9	11.8	121.7
2046	105.6	11.8	117.4	107.2	11.8	119.0	109.2	11.8	121.0
2047	105.3	11.8	117.1	106.8	11.8	118.6	108.6	11.8	120.4
2048	105.4	11.8	117.2	106.7	11.8	118.5	108.4	11.8	120.2
2049	104.8	11.8	116.6	106.1	11.8	117.9	107.7	11.8	119.5
2050	104.6	11.8	116.4	105.8	11.8	117.6	107.4	11.8	119.2
2051	104.4	11.8	116.2	105.6	11.8	117.4	107.1	11.8	118.9

Year	GWP for low-case (kton CO_2e)			GWP mid-case (kton CO_2e)			GWP high-case (kton CO_2e)		
	FPSO	ERRV, Supply Vessel, Heli-copter	Total	FPSO	ERRV, Supply Vessel, Heli-copter	Total	FPSO	ERRV, Supply Vessel, Heli-copter	Total
2052	104.6	11.8	116.4	105.6	11.8	117.4	107.0	11.8	118.8
2053	104.2	11.8	116.0	105.1	11.8	116.9	106.5	11.8	118.3
2054	104.0	11.8	115.8	104.9	11.8	116.7	106.2	11.8	118.0
2055	103.9	11.8	115.7	104.8	11.8	116.6	106.0	11.8	117.8
Total over life of field	**2,885**	**303**	**3,188**	**3,001**	**303**	**3,304**	**3,065**	**303**	**3,368**

The FPSO will use produced gas as its main fuel source. A fuel gas consumption profile has been developed based on the production profiles, project heat and material balance and electrical load schedule which establishes facility power demand. The estimated peak fuel gas rate (on an annualised average basis) is anticipated to remain relatively flat throughout the life of field, resulting in an average GWP around 117.9 tonnes per year and peaking at 162.3 tonnes in 2031 (based on the high-case scenario). Produced gas will be supplemented by gas imported from the West of Shetland pipeline system (WOSPS) pipeline system when the field becomes fuel gas deficient (subject to commercial negotiations), and therefore there will be relatively low consumption of diesel for power generation. Occasional running of power generation on diesel will be required in the event that fuel gas import is not available, or recovery from shutdown requires re-start on liquid fuel.

As such, there are no routine users of diesel during normal production operations. For the purposes of estimating emissions, a diesel consumption figure for Cambo has been determined assuming 6 production re-starts (8 hrs each) per year with main power generation on diesel fuel. In addition, small amounts of diesel will be used for the periodic testing of the emergency generators, testing of the fire water pumps and for inert gas generation.

During the first few months of production, while commissioning operations are also still taking place, diesel consumption will be relatively high, due to inert gas generation (as explained above in Section 9.1.4), resulting in a GWP for diesel consumption of 16,965 tonnes of CO_2e in 2030 and 15,849 tonnes of CO_2e in 2031. In the subsequent years of full production from 3032 until the anticipated end of field life in 2055, diesel consumption onboard the FPSO is estimated to be around 76.5 tonnes per year, resulting in an associated GWP of 245 tonnes CO_2e per year. The associated GWP of these emissions are included in the total quoted in Table 9.6 above.

As explained in Section 4.6.8, all processing facilities on the FPSO will be designed to operate without the need for routine flaring of hydrocarbons for operational purposes. It is anticipated that (as a worst-case estimate) up to 0.92 MSm^3 of occasional flaring per year is anticipated

during process upsets and other emergency situations. The associated GWP of these emissions are included in the total quoted in Table 9.6 above.

Figure 9.1 displays GHG emissions and intensity from the FPSO over the life of the proposed Cambo field development. The GHG intensity calculation is based upon the total GHG emissions (calculated GWP in tonnes of CO_2 equivalent) from the Cambo field divided by the total amount of hydrocarbons produced (i.e. oil + gas) expressed as 'barrels of oil equivalent' (boe) on an annual basis, over the expected production life of the field. The calculation excludes emissions arising from installation and decommissioning activities. Figure 9.1 shows that the GHG intensity during the first few months of production 2030 is 31.2 kg CO_2e/boe, when the development is still being commissioned. Once commissioning operations are completed, this drops to 8.5 kg CO_2e/boe in 2034 and then gradually increases throughout the life of field up to 44.0 kg CO_2e/boe at the end of field life in 2055.

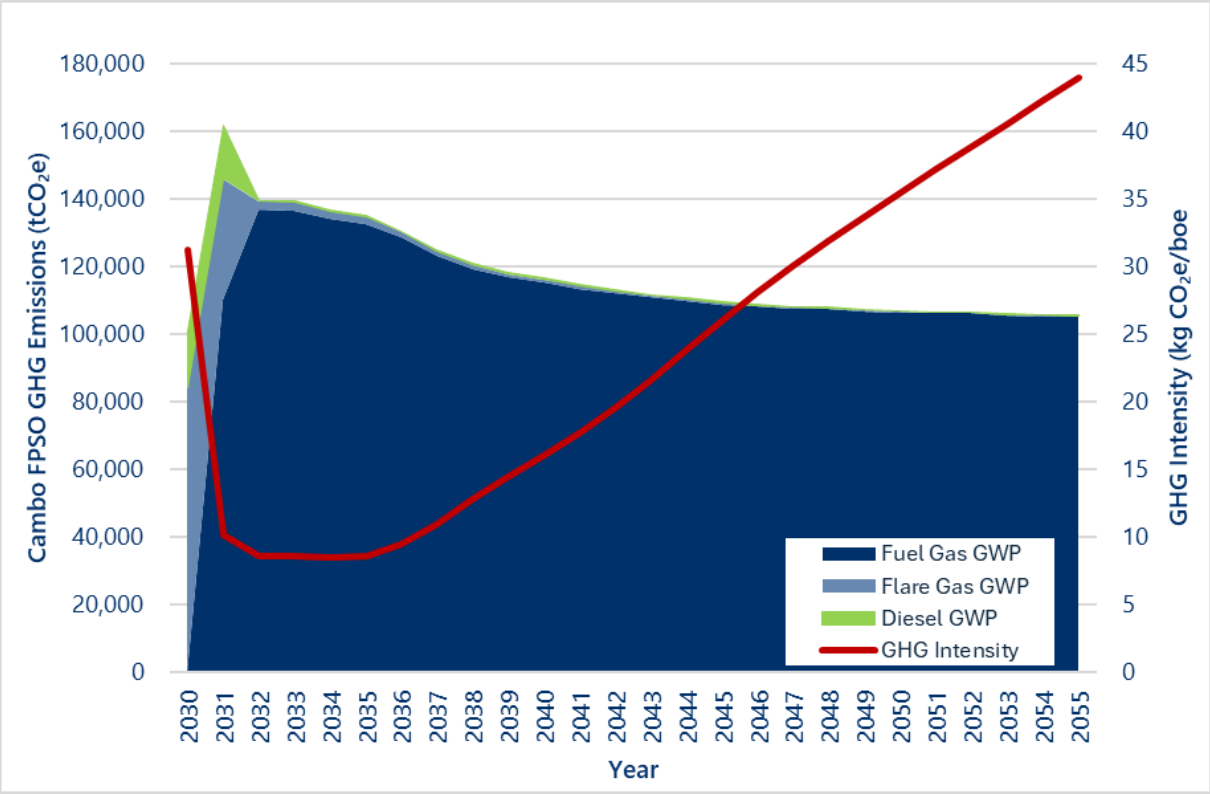


Figure 9.1: Greenhouse gas emissions and intensity for the Cambo field

Lastly, it is estimated that approximately 390.5 tonnes of CO_2e will be released into the atmosphere from fugitive emissions from connection/flanges, valves, pumps, etc onboard the Cambo FPSO, based on Leak Detection And Repair (LDAR) survey data from similar FPSOs (ENI Progetti, 2026). In order to put these GHG emissions into context, we can compare the average greenhouse intensity of the Cambo FPSO over its life of field (low-case: 24.47 CO_2e/boe, mid-case: 19.39 CO_2e/boe and high-case: 16.05 CO_2e/boe) to those of all offshore oil and gas installations currently operating on the UKCS, as reported to the Environmental and Emissions Monitoring System (EEMS) in 2024. Figure 9.2 shows that the average GHG intensity of the Cambo FPSO over its life of field will be on the lower end of the scale compared to all

installations currently operating on the UKCS, including all other FPSOs, which are coloured in dark blue in the figure.

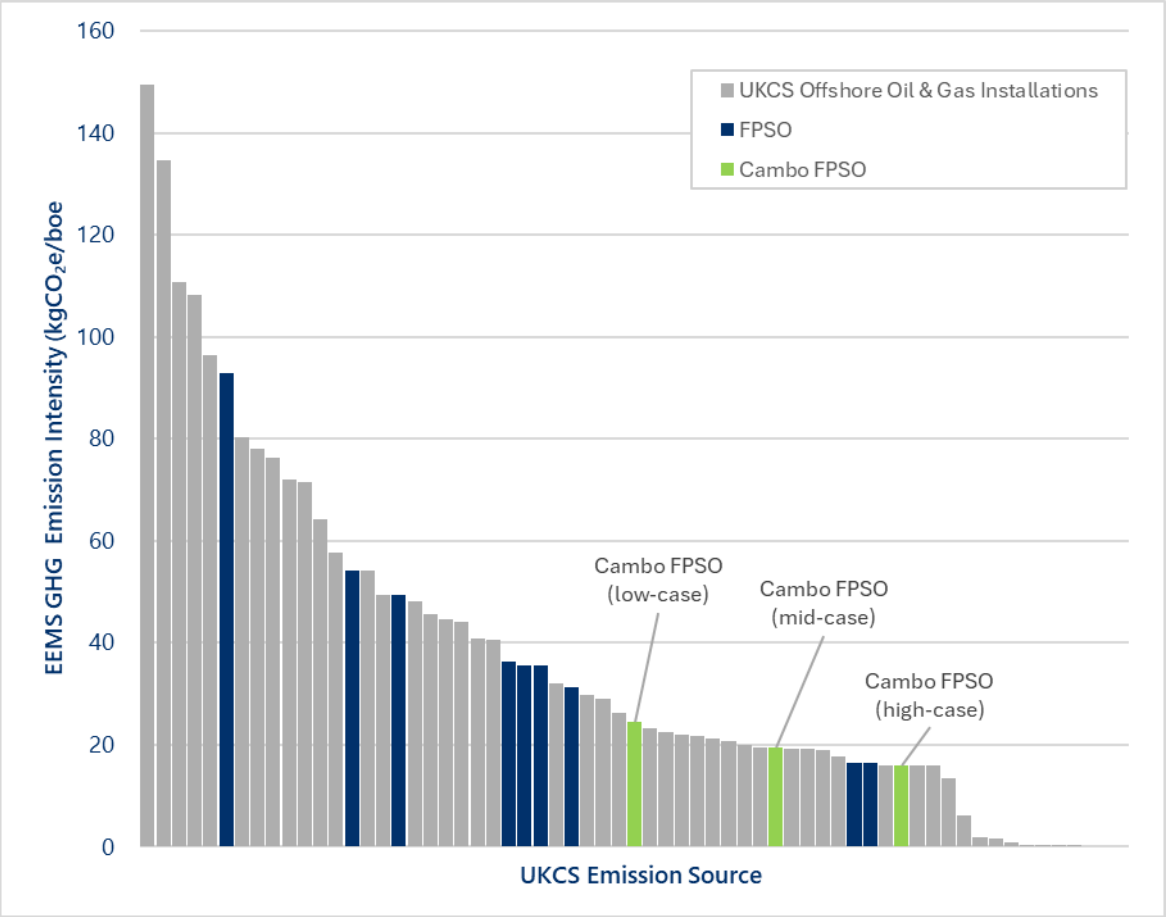


Figure 9.2: Greenhouse gas intensity from all UKCS oil and gas installations in 2024 (NSTA, 2025a)

9.1.6 Estimation of Downstream Combustion Emissions of Produced Hydrocarbons (Scope 3, Category 9, 10 and 11 emissions)

In addition to the upstream emissions discussed above, the impact assessment also looks at the emissions downstream from the point where the hydrocarbons leave the Cambo FPSO for export. These estimates include the CO_2e generated from the transportation, distribution and processing (refining) and the ultimate combustion of produced Cambo hydrocarbons by the end user and are based on the UK Government GHG Conversion Factors for Company Reporting (DESNZ, 2025). The estimates for transportation, distribution and processing (refining) Scope 3, categories 9 and 10 emissions have been calculated by deducting the Cambo upstream CO_2e emissions from the overall values calculated using the DESNZ conversion factors, as these are already covered in Table 9.6 above.

For the combustion of the produced Cambo hydrocarbons by the end user the conversion factor for 'fuel oil' has been used as a representative proxy for the produced Cambo oil and 'natural gas (100 % mineral blend)' as a proxy for the produced Cambo gas. These conversion factors are essentially independent of application as they assume that all fuel is fully oxidised

and combusted. They are based on an activity-weighted average of all the different CH_4 and N_2O conversion factors from the UK's greenhouse gas inventory for 2023, to allow for the variety of potential end users (DESNZ, 2025).

Table 9.7 presents the downstream Scope 3 emissions (categories, 9, 10 and 11) for the low-case, mid-case and high-case production scenarios.

Table 9.7: Cambo downstream Scope 3 emissions

Year	Low-case			Mid-case			High-case		
	Category 9, 10 (kton CO_2e)	Category 11 (kton CO_2e)	Total (kton CO_2e)	Category 9, 10 (kton CO_2e)	Category 11 (kton CO_2e)	Total (kton CO_2e)	Category 9, 10 (kton CO_2e)	Category 11 (kton CO_2e)	Total (kton CO_2e)
2030	51	234	285	52	238	290	52	237	289
2031	1,398	7,154	8,552	1,396	7,187	8,583	1,395	7,151	8,546
2032	1,427	7,186	8,61	1,437	7,272	8,709	1,432	7,231	8,663
2033	1,134	5,810	6,945	1,430	7,222	8,652	1,429	7,215	8,644
2034	766	4,078	4,844	1,393	7,016	8,409	1,424	7,166	8,590
2035	567	3,147	3,714	1,096	5,627	6,723	1,403	7,062	8,465
2036	436	2,539	2,975	814	4,302	5,116	1,220	6,196	7,416
2037	347	2,124	2,471	633	3,453	4,086	980	5,075	6,055
2038	283	1,828	2,111	505	2,854	3,359	791	4,189	4,980
2039	237	1,617	1,854	391	2,328	2,719	665	3,601	4,266
2040	199	1,442	1,641	313	1,968	2,281	575	3,181	3,756
2041	165	1,287	1,452	267	1,752	2,019	498	2,823	3,321
2042	138	1,162	1,300	234	1,599	1,833	431	2,514	2,945
2043	117	1,063	1,180	205	1,466	1,671	376	2,258	2,634
2044	98	976	1,074	180	1,354	1,534	324	2,018	2,342
2045	83	907	990	158	1,253	1,411	280	1,814	2,094
2046	69	841	910	139	1,163	1,302	246	1,657	1,903
2047	58	792	850	121	1,082	1,203	219	1,533	1,752
2048	48	746	794	106	1,014	1,120	197	1,432	1,629
2049	39	701	740	92	948	1,040	177	1,339	1,516
2050	30	662	692	80	893	974	160	1,261	1,421
2051	23	629	652	70	845	915	145	1,190	1,335
2052	17	600	617	60	800	860	132	1,131	1,263
2053	11	572	583	51	757	808	119	1,072	1,192
2054	5	547	552	42	717	759	108	1,019	1,127
2055	0	524	524	36	687	723	97	971	1,068
Total	**7,746**	**49,168**	**56,914**	**11,301**	**65,797**	**77,098**	**14,875**	**82,336**	**97,211**

The table shows that the low-case and mid-case production profiles would result in 40.5 % and 20.7 % less downstream Scope 3 emissions compared to the high-case production profile, respectively.

It should be noted that these calculations are based on a wide range of assumptions and the best estimates currently available. The Scope 3 category 9, 10 and 11 estimates should therefore be considered to provide an indication of scale only for the purpose of putting them into context in relation to current global carbon emissions, national emission reduction targets and projected potential climate change trajectories.

9.1.7 Summary of all Emissions Combined over the Cambo Life of Field

Table 9.8 combines all upstream emissions presented Table 9.3 to Table 9.6 and the fugitive emissions, as well as the downstream emissions presented in Table 9.7, hence summarising all emissions over the life of field based on the high-case production scenario.

Table 9.8: Summary of all CO_2e emissions combined over life of field

Year	Upstream				Downstream		Total
	Drilling and Completion (kton CO_2e)	Subsea Installation (kton CO_2e)	Well Clean-up and Commissioning Flaring (kton CO_2e)	Production (Cambo FPSO, ERRV, Supply vessel and Helicopter emissions (kton CO_2e)	Transportation, distribution and processing (refining) (kton CO_2e)	End User Combustion Emissions (kton CO_2e)	Total (kton CO_2e)
2028	28	3	--	--	--	--	31
2029	112	15	--	--	--	--	127
2030	84	11	147	109	52	237	640
2031	--	--	--	174	1,395	7,151	8,720
2032	--	--	--	152	1,432	7,231	8,815
2033	--	--	--	152	1,429	7,215	8,796
2034	--	--	--	149	1,424	7,166	8,739
2035	--	--	--	147	1,403	7,062	8,612
2036	--	--	--	143	1,220	6,196	7,559
2037	--	--	--	137	980	5,075	6,192
2038	--	--	--	133	791	4,189	5,113
2039	--	--	--	130	665	3,601	4,396
2040	--	--	--	129	575	3,181	3,885
2041	--	--	--	127	498	2,823	3,448
2042	--	--	--	125	431	2,514	3,070
2043	--	--	--	124	376	2,258	2,758

Year	Upstream				Downstream		Total
	Drilling and Completion (kton CO_2e)	Subsea Installation (kton CO_2e)	Well Clean-up and Commissioning Flaring (kton CO_2e)	Production (Cambo FPSO, ERRV, Supply vessel and Helicopter emissions (kton CO_2e)	Transportation, distribution and processing (refining) (kton CO_2e)	End User Combustion Emissions (kton CO_2e)	Total (kton CO_2e)
2044	--	--	--	123	324	2,018	2,465
2045	--	--	--	122	280	1,814	2,216
2046	--	--	--	121	246	1,657	2,024
2047	--	--	--	120	219	1,533	1,873
2048	--	--	--	120	197	1,432	1,749
2049	--	--	--	120	177	1,339	1,636
2050	--	--	--	119	160	1,261	1,540
2051	--	--	--	119	145	1,190	1,454
2052	--	--	--	119	132	1,131	1,382
2053	--	--	--	118	119	1,072	1,309
2054	--	--	--	118	108	1,019	1,245
2055	--	--	--	118	97	971	1,186
Total	**224**	**29**	**147**	**3,368**	**14,875**	**82,336**	**100,979**

The table shows that the overall upstream and downstream GHG emissions during the drilling, construction and commissioning phase of the Cambo field development vary between 31 kton CO_2e in 2028 to 640 kton CO_2e in 2030, when Cambo starts producing. During its first full year of production the GHG emissions rise to 8,702 kton CO_2e in 2031 and peak the following year at 8,815 kton CO_2e in 2032, after which they gradually decline to 1,186 kton CO_2e in 2055. Over its entire life of field, it is estimated that the Cambo field development will generate 100,979 kton CO_2e.

9.2 Putting the Cambo Emissions into Context

The emissions listed in Sections 9.1.2 to 9.1.7 above can be put into context by comparing them with the current emissions from the UK's oil and gas industry and to see how the high-case Cambo production profile fits in with the North Sea Transition Authority (NSTA) targets for the UK oil and gas industry, as described in the Oil and Gas Authority (OGA) Strategy and the North Sea Transition Deal (NSTD).

In 2024, GHG emissions from oil and gas production in the UK, which includes emissions from offshore oil and gas fields, onshore processing terminals and oil and gas exploration activity, totalled an estimated 11.8 Mt CO_2e (Figure 9.3). Of this, 81 % originated from offshore facilities which extract and initially process oil and gas. Emissions from the production of oil and gas in

the UK declined by 7 % between 2023 and 2024, a fifth consecutive year of reductions (NSTA, 2025b). Overall, all upstream oil & gas emissions combined make up approximately 3 % of the total UK greenhouse gas emissions.

Figure 9.3: Emissions from UK oil and gas production (Source: NSTA, 2025b)

When comparing Cambo's annual upstream[2] emissions against the 11.8 Mt CO_2e for all UK oil and gas production GHG emissions combined in 2024 as a baseline (NSTA 2025b), Cambo would contribute up to 1.5 % to this total when it starts producing oil and gas in 2030. This initial peak in emissions is strongly influenced by well clean-up and commissioning flaring operations which make up nearly half (42 %) of this total (see Table 9.8). During peak production in 2032 / 2033, the Cambo emissions will account for approximately 1.3 % compared to the 2024 baseline value. From 2034 onwards, both oil and gas production and associated upstream production emissions at Cambo start to decline gradually. In its last year of production in 2055, Cambo's contribution will have reduced to 1.0 % compared to the baseline value.

The OGA strategy sets out a Central Obligation which commits all parties involved to undertake steps necessary to:

- Secure that the maximum value of economically recoverable petroleum is recovered from the strata beneath relevant UK waters; and, in doing so,
- Take appropriate steps to assist the Secretary of State in meeting the net zero target, by reducing as far as reasonable in the circumstances greenhouse gas emissions from sources such as flaring, venting and power generation, and supporting carbon capture and storage projects (OGA, 2021).

[2] The term 'upstream' in this context means all emissions associated with Cambo, until the produced fluids leave the Cambo FPSO.

Government forecasts show that oil and gas will remain an important part of the energy mix for the foreseeable future, including under Net Zero (NSTA, 2025c). Presently, the projected oil and gas requirements for the UK in 2050 are 14.5 million tonnes of oil equivalent (Mtoe) for oil and 9.2 Mtoe for gas (NSTA, 2024).

Figure 9.4 shows the trajectory of the amount of natural gas that the UK as a country is projected to require between 2024 and 2050, including the provision for new gas developments and the contribution that Cambo will make to this. The figure shows that the projected gas production from the proposed Cambo field development fits in well within the anticipated production targets, taking up only a small part of the amount allocated for new developments.

Whereas all produced Cambo gas is expected to be used domestically in the UK, the produced oil will be exported via shuttle tanker and made available for sale on the open market. It is therefore not possible to predict what fraction of the refined end products made out of the produced Cambo oil will end up on the UK market, and therefore a direct comparison on how much Cambo oil will be produced in relation to the oil products requirement for the UK is not appropriate. Nonetheless, Figure 9.5 provides some context on how the amount of oil produced at Cambo compares to the forecasted overall oil requirement of the UK.

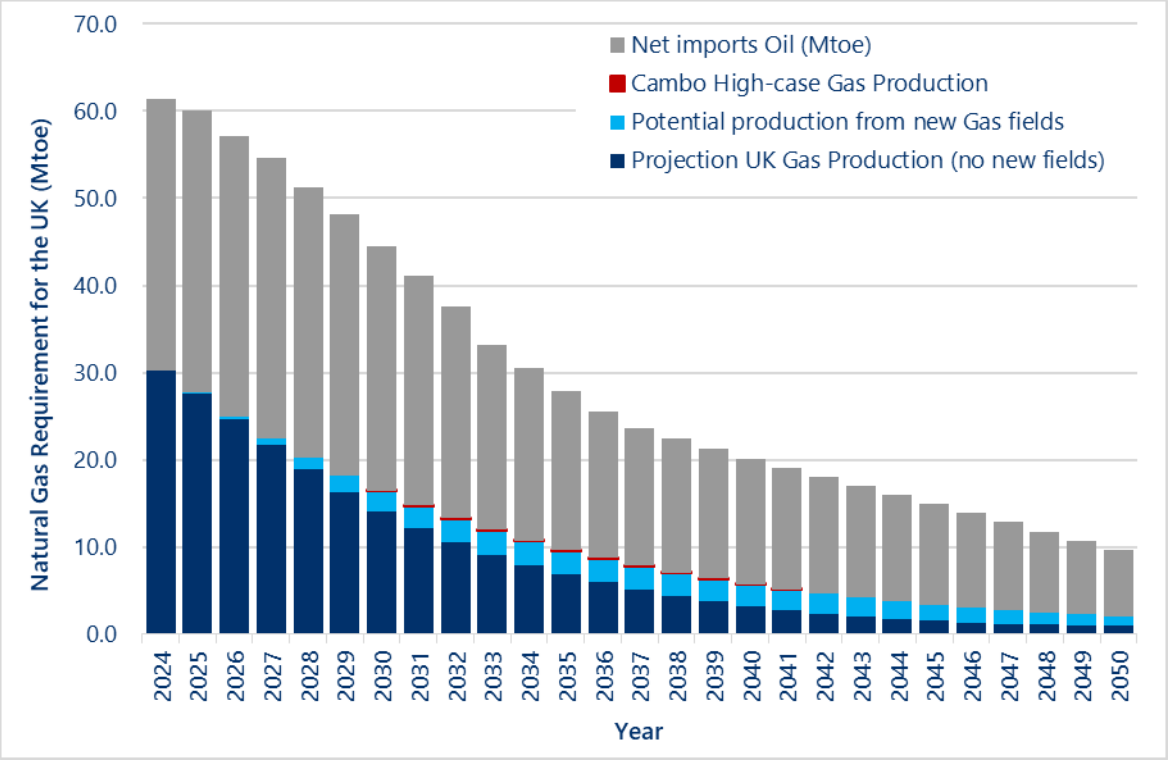


Figure 9.4: Projected gas requirements for the UK (NSTA, 2024)

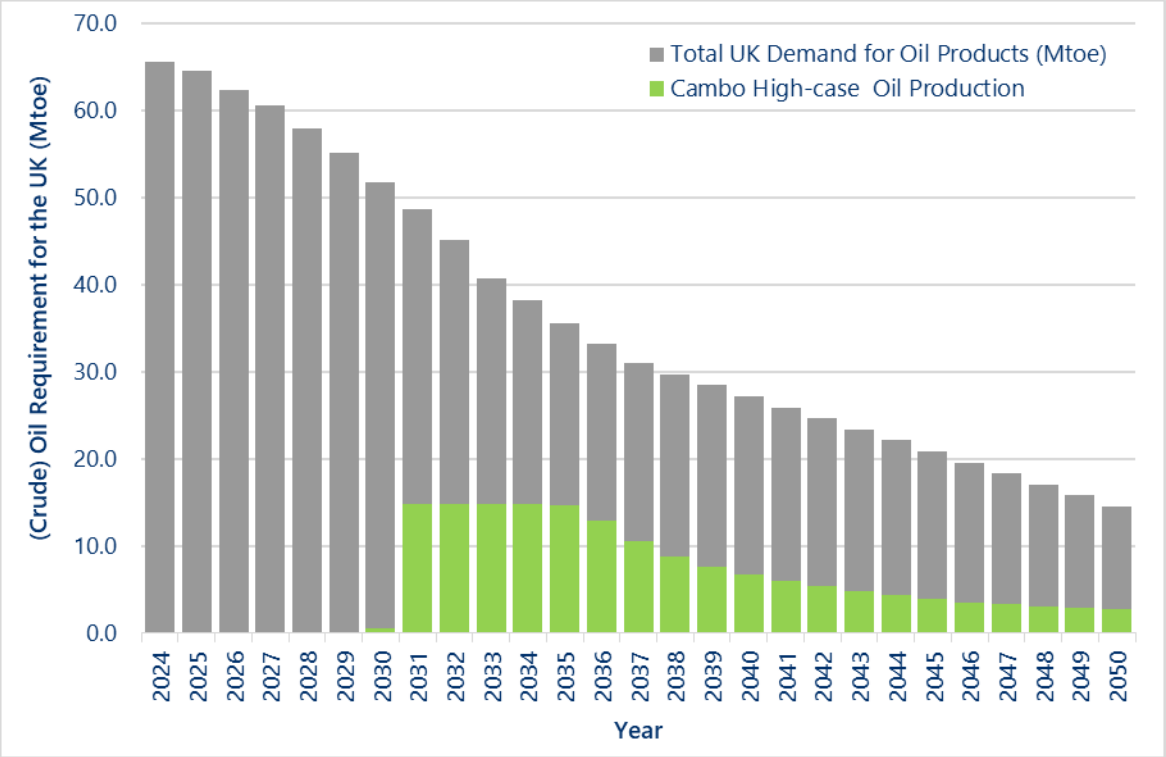


Figure 9.5: Projected oil requirements for the UK (NSTA, 2024)

The NSTD is an agreement between the UK government and the oil and gas industry which includes upstream emissions reduction targets of 10 % by 2025, 25 % by 2027 and 50 % by 2030 in support of the UK's pathway to net-zero by 2050, all against a 2018 baseline (NSTA, 2021; NSTA, 2022b). The UK upstream oil and gas sector has set itself additional targets, starting from a 50 % reduction in 2030 to 90 % in 2040 (against a 2018 baseline) and to become a net zero basin by 2050 (OGUK, 2020). The UK oil and gas industry is currently on track to meet, and is forecasted to slightly exceed, the NSTD targets up to 2030 (Figure 9.6). Upstream oil and gas emissions are projected to continue to reduce beyond 2030, with the reduction rates depending on the amount of additional mitigation that will be implemented.

The 'business as usual' projection (dark blue line in Figure 9.6) represents a continuation of the current trend in the UK's oil and gas industry, which follows a gradually declining trajectory based on the cessation of production of installations over the next few decades. The dark blue line provides a reference point against which the potential impact of future abatement measures can be assessed in relation to the NSTD and industry targets and is not intended to represent the most likely emissions pathway, as the NSTA both anticipates and requires continued abatement efforts (NSTA, 2025b).

The lime green, light blue and orange lines present pathways based on a range of additional measures, including the implementation of zero routine flaring and venting from 2030 onwards, in combination with 3 different electrification scenarios for offshore installations (based on high, mid and low range electrification, respectively).

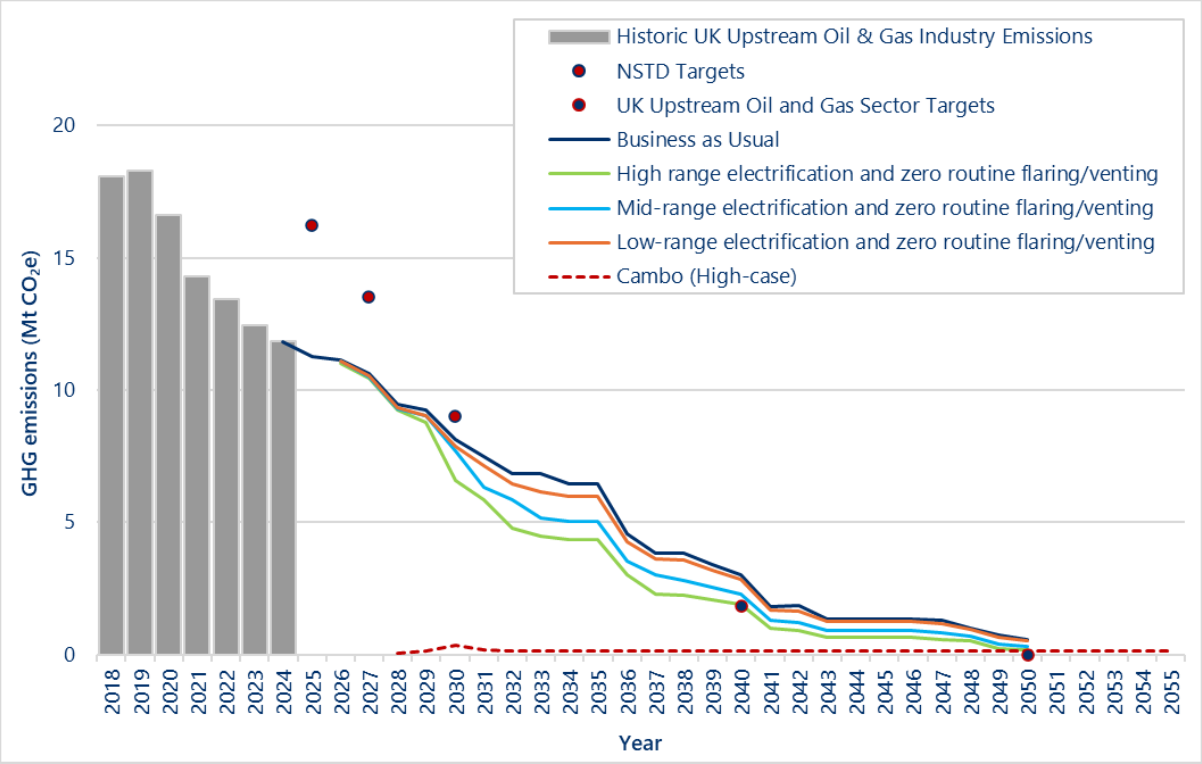


Figure 9.6: Current trend and projected upstream CO_2 emissions from the UK upstream oil & gas industry (Source: NSTA, 2025b)

9.2.1 UK Carbon Budgets

As described in the Local Environment chapter of the ES (Section 5.8.4), the UK as a country has set itself legally binding carbon targets to reach net zero by 2050, under the Climate Change Act (2008). The Act requires the Government to set periodic carbon budgets every 5 years, known as 'nationally determined contributions' (NDCs), to ensure the UK reaches Net Zero by 2050. In 2019, the UK committed itself to reach Net Zero greenhouse gas emissions by 2050, with any residual greenhouse gas emissions balanced by removals. To date, targets have been set for the period up to 2042 (see Table 5.17). In order to meet these targets, the UK's climate change committee (CCC) has set out a strategy known as 'the Balanced Pathway', on which the NDCs are based.

The high-case upstream GHG emissions from the Cambo field development will peak at 351 kton CO_2e in 2030 during the commissioning and start-up of the FPSO, mainly due to well clean-up and commissioning flaring operations which make up 147 kton CO_2e of this total (see Table 9.8). Once in full production, from 2031 onwards, the annual upstream emissions from Cambo will be around 130 kton of CO_2e per year on average, over the life of field. The overall upstream oil and gas emissions in the UK were 11.8 million tonnes of CO_2e. Therefore, using 2024 as a baseline year, Cambo's emissions in relation to the whole of the UK oil and gas upstream sector, will contribute up 2.97 % during its peak year in 2030 and 1.10 % on average per year during the production phase from 2031 onwards.

As explained in Section 4.6.4, the produced Cambo export gas will be fed into the National Transmission System, to be used for power generation by the National Grid, to supply heating and hot water to homes and businesses, and to fuel industrial processes in Great Britain. The crude oil produced at Cambo will be exported to the global market for refining and further processing, and hence no estimation can be made of how much of the Cambo oil will ultimately be used domestically.

The overall Cambo emissions (including its combined Scope 1 and Scope 3, Category 4, 6, 9, 10 and 11 emissions) will contribute a small part of the projected annual UK target carbon budgets set, remaining broadly in line with the Balanced Pathway strategy towards Net Zero by 2050, as shown in Table 9.9. However, Cambo's relative contribution increases gradually and will continue to produce emissions until 2055, beyond the UK's 2050 Net Zero target. Therefore, as a minimum, Ithaca Energy will meet all necessary legal and industry-wide agreed greenhouse gas removal (GGR) requirements that may be implemented by the UK government and Offshore Energies UK (OEUK) to offset industrial GHG emissions produced after 2050 in support of the UK's Net Zero commitment.

Table 9.9: Cambo emissions in relation to UK Carbon Budgets

Year	UK's Balanced Pathway towards Net Zero in 2050	Cambo upstream emissions (Scope 1 and Scope 3, Category 4 and 6 emissions)		Cambo Oil downstream emissions (Scope 3, Category 9,10 and 11 emissions		Cambo Gas downstream emissions (Scope 3, Category 9,10, and 11 emissions)	
	Amount [kton CO_2e]	Amount [kton CO_2e]	Fraction of UK Carbon budget	Amount [kton CO_2e]	Fraction of UK Carbon budget*	Amount [kton CO_2e]	Fraction of UK Carbon budget
2028	355,012	31	0.0087 %	--	--	--	--
2029	326,860	127	0.0389 %	--	--	--	--
2030	295,757	351	0.1188 %	< 279	< 0.1 %	10	0.003 %
2031	271,054	174	0.0642 %	< 8,453	< 3.1 %	268	0.099 %
2032	249,041	152	0.0610 %	< 8,479	< 3.4 %	336	0.135 %
2033	228,398	152	0.0664 %	< 8,457	< 3.7 %	338	0.148 %
2034	208,153	149	0.0715 %	< 8,458	< 4.1 %	280	0.135 %
2035	186,996	147	0.0788 %	< 8,359	< 4.5 %	253	0.135 %
2036	169,338	143	0.0843 %	< 7,372	< 4.4 %	187	0.111 %
2037	151,338	137	0.0906 %	< 6,070	< 4.0 %	122	0.081 %
2038	135,119	133	0.0985 %	< 5,040	< 3.7 %	73	0.054 %
2039	121,774	130	0.1070 %	< 4,357	< 3.6 %	39	0.032 %
2040	107,703	129	0.1195 %	< 3,867	< 3.6 %	17	0.016 %
2041	91,287	127	0.1389 %	< 3,446	< 3.8 %	1	0.002 %
2042	77,283	125	0.1621 %	< 3,070	< 4.0 %	0	0.000 %
2043	65,287	124	0.1897 %	< 2,758	< 4.2 %	0	0.000 %
2044	54,071	123	0.2273 %	< 2,465	< 4.6 %	0	0.000 %
2045	42,468	122	0.2865 %	< 2,215	< 5.2 %	0	0.000 %
2046	33,330	121	0.3629 %	< 2,024	< 6.1 %	0	0.000 %

Year	UK's Balanced Pathway towards Net Zero in 2050	Cambo upstream emissions (Scope 1 and Scope 3, Category 4 and 6 emissions)		Cambo Oil downstream emissions (Scope 3, Category 9,10 and 11 emissions		Cambo Gas downstream emissions (Scope 3, Category 9,10, and 11 emissions)	
	Amount [kton CO_2e]	Amount [kton CO_2e]	Fraction of UK Carbon budget	Amount [kton CO_2e]	Fraction of UK Carbon budget*	Amount [kton CO_2e]	Fraction of UK Carbon budget
2047	24,576	120	0.4899 %	< 1,873	< 7.6 %	0	0.000 %
2048	16,088	120	0.7474 %	< 1,749	< 10.9 %	0	0.000 %
2049	7,895	120	1.5140 %	< 1,635	< 20.7 %	0	0.000 %
2050	-1,107	119	--	< 1,540	N/A	0	--
2051	--	119	--	< 1,454	N/A	0	--
2052	--	119	--	< 1,381	N/A	0	--
2053	--	118	--	< 1,310	N/A	0	--
2054	--	118	--	< 1,245	N/A	0	--
2055	--	118	--	< 1,186	N/A	0	--

Notes:

* = The produced Cambo gas will be (exclusively) used for the UK market and therefore its associated Scope 3, Category 9,10, and 11 emissions its associated will also count directly towards to the UK's carbon budget. In contrast the produced Cambo oil will be exported to the global market for refining and further processing, and hence no estimate can be made of how much of it will ultimately be processed and used domestically. Consequently, the fraction of the carbon budget for Scope 3 category 9, 10 and 11 oil emissions associated with the processing, transporting and end user combustion of the Cambo oil has been included only to show their relative scale, as the actual fraction ultimately counting towards the UK's carbon budget will be significantly lower.

9.2.2 Global CO_2 Targets

Lastly, Cambo's combined emissions are considered in respect of global emissions targets set out in the Paris Agreement[3]. As shown in Table 9.8 above, the annual combined upstream and downstream emissions comprising all Scope 1 and all Scope 3, Category 4, 6, 9, 10 and 11 emissions, vary between 31 kt CO_2e and 8,815 kt CO_2e per year over the Life of Field of the proposed Cambo field development. As referred to in the previous section, each party (i.e. country) signed up to the Paris Agreement has to submit the periodic NDCs. By combining all NDCs together, these climate actions determine whether the world achieves the long-term goals of the Paris Agreement. The goals aim to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century, by reaching global peaking of GHG emissions as soon as possible and to undertake rapid reductions thereafter in accordance with best available science. As shown in Figure 5.34 (and Figure 9.7 below), the 2024 NDC Synthesis Report (UNFCCC, 2024) shows that, based on the current unconditional NDC commitments made by all contracting Parties being fully implemented, GHG emissions are estimated to rise over the next few years to be

[3] The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 195 Parties (including the UK) at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016.

51.5 (48.3-54.7) Gt CO_2e by 2030[4] (or slightly lower at 49.8 (48.3-51.2) Gt CO_2e by 2030 when taking into account all conditional NDC elements as well), before stabilising or slightly reducing.

Figure 9.7 shows how the current NDCs up to 2030 relate to the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) shared socioeconomic pathways (SSPs), described in Section 5.5.5. The figure shows that the newest NDCs are gradually starting to move towards the SSP1-2.6 pathway, although additional and sustained future commitments from all parties signed up to the Paris Agreement will still be required to reach the blue pathway limiting global warming to 2 ºC or the even lower turquoise pathway of 1.5 ºC with no, or limited, overshoot as characterised by SSP-1.9.

When assessing how the Cambo emissions relate to these global GHG targets it should be borne in mind that: 1) Oil and gas will remain an important part of the planet's energy mix during the energy transition and even after reaching Net Zero in 2050 or later; and 2) Cambo is expected to produce hydrocarbons until 2055. Hence, the exploitation of the Cambo field reserves is considered to be in line with the overarching global emissions targets set out in the Paris Agreement and will not put at risk the global energy transition.

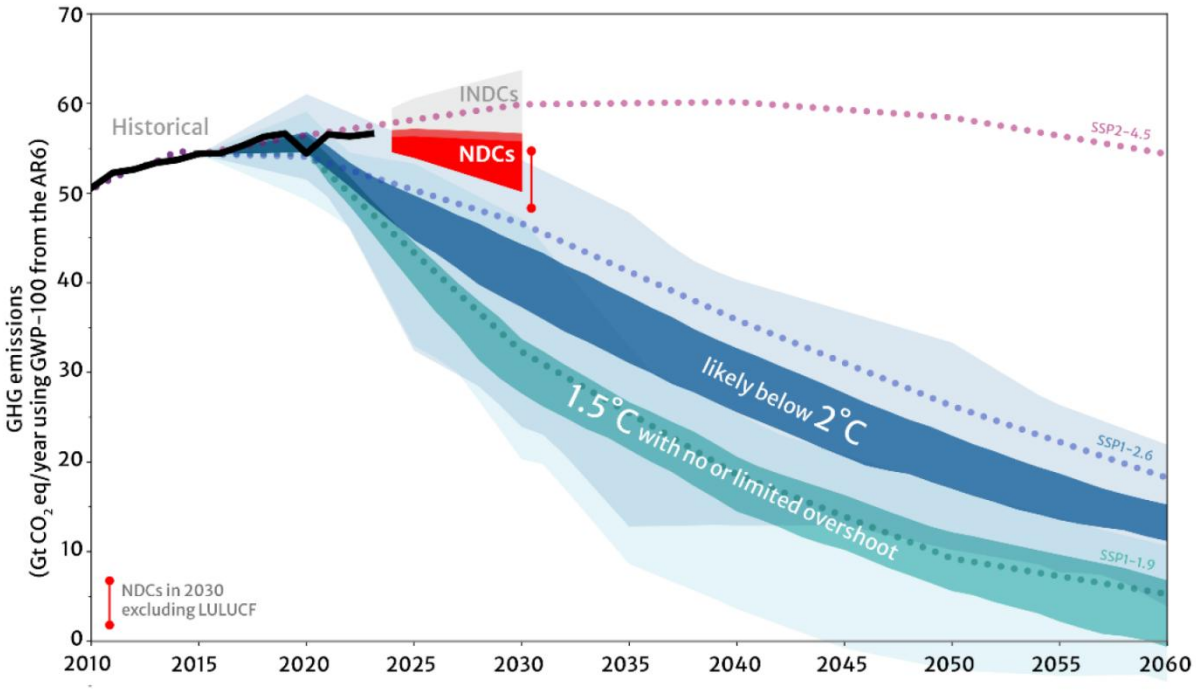


Figure 9.7: Comparison of current global NDCs in relation to the IFCC AR6 SSP pathways (UNFCCC, 2024)

9.3 Assessment of Localised and Regional Air Pollution Impacts

Combustion emissions have the potential to reduce local air quality through the introduction of contaminants such as NO_X, VOCs and particulates which contribute to regional acid gas

[4] These numbers do not include the GHG contribution from land use, land-use change and forestry (LULUCF). For comparison, the global emissions including Land Use, Land-Use Change and Forestry (LULUCF) in 2030 are estimated as 55.2 (53.9–56.6) Gt CO_2e considering unconditional elements and 51.7 (50.2–53.1) Gt CO_2e assuming full implementation.

loads and may result in local low-level ozone and photochemical smog formation. SO_2 and NO_2 are known to be involved in acid deposition and the human health effects of particulates are still poorly understood but appear to have a considerable impact (BEIS, 2022a; 2022b; DECC, 2016).

However, the MODU and vessels used during the drilling and construction phases are built and operated to meet regulated air quality standards that preclude impacts to the health of crews, whilst other environmental receptors present in the immediate vicinity of the operations (e.g. flora and fauna) tend to be sparsely distributed and/or mobile in their distribution.

The nearest manned oil and gas installation to the proposed Cambo FPSO will be the (future) Rosebank FPSO, to be situated at 28.4 km distance. The distance between the proposed Cambo FPSO location and the existing Schiehallion FPSO will be 50.4 km. Given these distances, it is not expected that changes to air quality will be noticeable and/or measurable at these receptor locations.

All Cambo related local and regional air pollution emissions will only form a small contribution to overall UK atmospheric emissions, and any potential local and regional pollution effects are further mitigated by their long distance from shore (133 km) and any other receptors allowing for significant dispersal, so effects on coastal and terrestrial air quality are unlikely to be significant (DECC, 2016).

Therefore, the magnitude of effect of localised and regional air pollution has been classed as '**Negligible**'. Consequently, regardless the receptor level that may be affected, the resulting overall effect will the '**Negligible**' to '**Minor adverse**' and therefore can be considered as not significant.

9.4 Cumulative Global Climate Change Impacts

As described in Section 7.3.1 to 7.3.3 of the impact assessment methodology, the assessment of GHG emission impacts differs from the other impacts assessed in this Environmental Statement (ES), as they contribute to cumulative global effects, rather than having a direct impact affecting a discrete localised area that can be directly attributed to a specific emission source. The atmospheric concentration of GHGs and resulting effect on climate change is affected by all carbon emission sources and sinks globally, anthropogenic and otherwise (IEMA, 2022).

The crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline and achieving net zero by 2050, in line with internationally agreed (i.e. in line with the Paris Agreement) and UK government and industry specific targets (IEMA, 2022). For the oil and gas industry the latter are set out in the NSTD, as described in Sections 5.5.3 and 5.5.4.

The cumulative impact of the Cambo GHG emissions can therefore be determined by assessing how the Cambo emissions relate to and fit in with the global-reduction pathways described in

Section 5.8.5. By contextualising the Cambo emissions in this way, the assessment becomes inherently cumulative, as these pathways take into account a wide range of existing and planned projects and other activities. Furthermore, with IPCC's Shared Socio-economic Pathways SSP1-1.9 and SSP1-2.6 effectively meeting the Paris agreement target of limiting global warming to 'well below' 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C they can be used as benchmarks for determining the significance of the effect.

Therefore, the impact assessment is based on how these GHG emissions contribute and fit in with the IPCC climate change commitment towards net zero, as implemented through the NSTD and in line with the Department for Energy Security & Net Zero's EIA guidance on the assessment of Scope 3 emissions on climate (DESNZ, 2025) and the Institute of Environmental Management & Assessment's guidance document on assessing greenhouse gases and evaluating their significance (IEMA, 2022).

Based on this guidance, the receptor value for all cumulative GHG emissions should be classed as being of '**High sensitivity**' to any further emissions. Consequently, any variation in the outcome of the impacts assessment will depend solely on the magnitude of effects described in Section 7.3.1.

When reviewing the proposed Cambo field development against industry specific, UK national and international emission reduction and global warming reduction targets, as detailed in Section 9.2, it can be concluded that the Cambo emissions are expected to be in line with a climate pathway that limits warming to 2 °C by 2100 but exceeds warming of 1.5 °C during the 21st century, i.e. an IPCC AR6 Category C3 pathways, as represented by SSP1-2.6. The magnitude of effect can therefore be classed as being '**Minor**'.

Consequently, the overall cumulative effect on global climate change is considered as '**Minor adverse**' and therefore may be considered as not significant. The GHG impacts associated with the proposed Cambo field development are consistent with applicable existing and emerging policy requirements and good practice design standards for this type of development. The minor adverse effects are in line UK policy and the measures necessary to achieve the UK's (as well as the global) trajectory towards net zero.

9.5 Mitigation Measures

Ithaca Energy's Net Zero targets are fully supportive of national and industry targets, by contributing to achieve:

1. The UK's NDC targets as set out in 'the Balanced Pathway' (CCC, 2025);
2. The NSTA targets for the UK oil and gas industry, as described in the OGA Strategy and the NSTD, including the upstream emissions reduction targets of 10 % by 2025, 25 % by 2027 and 50 % by 2030 in support of the UK's pathway to net-zero by 2050, all against a 2018 baseline (NSTA, 2021; NSTA, 2022); and

3. The UK upstream oil and gas sector emission targets of 50 % reduction in exploration and production emissions by 2030 and 90 % reduction in 2040, against a 2018 baseline in order to becoming a Net Zero basin by 2050 (OGUK, 2020).

Emissions reduction initiatives span operational controls, infrastructure modifications and technology adoption. The Cambo FPSO will therefore be designed with these targets in mind. Ithaca Energy is committed to work along with government and industry bodies, as well as with other industry partners, towards achieving these ambitious targets.

When scheduling the drilling operations, optimising fuel use will be considered, including batch drilling of the wells and the use of two drilling units during the summer months, for example, to minimise fuel use.

Low sulphur diesel will be used in accordance with International Maritime Organisation requirements.

The Cambo FPSO will be designed such that GHG emissions are minimised from the outset as far as is reasonably practicable and to accommodate potential future modifications over the life of field. For example, the FPSO will be designed to accommodate the installation of a future electrical infrastructure to facilitate electrical power import and eventual replacement (in whole or in part) of the proposed gas-turbine driven power and heat generation system. This could reduce direct emissions from FPSO operations by 42 to 47 % from the point of electrification, with residual emissions arising from intermittent non-routine flaring operations and diesel consumption.

There will no continuous routine flaring or venting of gas. Non-routine flaring and venting of hydrocarbon gas will be minimised by employing Best Available Techniques / Technology (BAT).

All equipment onboard will be well maintained according to a strict maintenance regime, including regular monitoring and inspections to ensure an effective maintenance regime is in place. The maintenance regime will ensure all equipment will operate at optimum efficiency and therefore minimise the overall fuel consumption.

The combustion plants onboard the MODU and FPSO will be fuel efficient and meet all current emission standards. For the first several years of production the Cambo FPSO will be powered by its own produced gas, until the Cambo field becomes gas deficient, which is currently expected to occur sometime between 2036 and 2042. If electrification can still not be achieved by this time, fuel gas may be imported via the Cambo gas export pipeline from the Rosebank / WOSPS system, which will help to minimise diesel consumption. All excess gas produced during the early years of production, beyond the gas required for power generation of the Cambo FPSO, will be exported to shore, contributing to the UK's energy transition to cleaner forms of fossil fuels.

9.6 Conclusions

Atmospheric emissions will be produced during drilling, installation and commissioning operations, as a result of fuel combustion onboard the MODU and FPSO, as well as onboard the standby vessel, supply vessels, subsea construction and support vessels and helicopters.

During the production phase, GHG emissions will be generated by the Cambo FPSO itself, as well as from the ERRV, supply vessels and helicopters servicing the FPSO. All these emissions are classed as upstream emissions and will generate up to 3,367 kton of CO_2e over its life of field (See Table 9.6 and Table 9.8).

In addition, downstream emissions will be generated during the transportation, distribution and processing (refining) of the produced Cambo hydrocarbons (14,873 kton CO_2e, see Table 9.8) and ultimately also during the combustion of the processed/refined oil and gas products by the end user (82,337 kton CO_2e, see Table 9.8).

Therefore, the assessment is based on all upstream and downstream emissions combined (i.e. all relevant scope 1, 2, and 3 emissions will result in a total of up to 100,979 kton CO_2e over the life of field of the proposed Cambo field development. All these emissions will contribute to local, regional and global environmental effects.

At the Cambo field development local and regional air pollution impacts are mitigated by Health and Safety measures in place to control emissions, the dispersive nature of the offshore environment and the lack of sensitive receptors in the area. As such, any local and regional air pollution effects are expected to be '**Negligible**' to '**Minor adverse**', and therefore not significant.

It is recognised that, cumulatively, the emissions associated with the proposed Cambo field development will also contribute to global climate change. However, as global climate change impacts resulting from individual projects and / or activities (including the proposed Cambo field development) cannot be assessed in isolation, cumulative global climate change impacts of individual projects have therefore been assessed on whether and how that project will contribute to, or put at risk, the achievement of industry, national and international climate change reduction targets, in line with DESNZ and IEMA guidance (DESNZ, 2025; IEMA, 2022). With respect to the proposed Cambo field development these targets include those set out in the North Sea Transition Deal (NSTA, 2021; NSTA, 2022b) and the UK upstream oil and gas sector targets for emissions (OGUK, 2020), the advice for the seventh carbon budget (CCC, 2025) and the overarching global emissions targets set out in the Paris Agreement, with the aim of keeping global warming to well below 2 °C and to pursue efforts to limit it to 1.5 °C above pre-industrial levels.

The contribution of the proposed Cambo field development and its associated emissions is comparable to similar sized operations on the UKCS and its greenhouse gas emissions intensity per produced barrel of oil will be on the lower end compared to all installations operating on the UKCS. Moreover, the proposed Cambo field development and its associated emissions are

in line with, and do not put at risk, the current energy transition trajectory towards Net Zero by 2050, as followed by the UK government through its Balanced Pathway strategy, as well as with the objectives agreed in the Paris (climate) Agreement.

Therefore, in this context, the effects of the overall contribution of all combined Cambo emissions generated during the drilling, installation, commissioning and operational life of field of the proposed Cambo field development (Scope 1 and Scope 3, Category 4 and 6 emissions), as well as those generated during the transportation, distribution and processing (Scope 3, Category 9 and 10 emissions) and end user combustion (Scope 3, Category 11 emissions) of the produced hydrocarbons on global climate change have been assessed as being '**Minor adverse**' and in line with the measures necessary to achieve the UK's (as well as the global) trajectory towards net zero and therefore can be considered to be not significant.

10. Drilling Discharges

This section addresses potential impacts associated with drilling discharges and which were raised during the Environmental Issues Identification (ENVID) workshop and informal stakeholder consultation and which are part of the National Marine Plan (NMP).

Identified impacts relate to discharges to sea on seabed and water column communities including:

- Discharge of payzone cuttings;
- Discharge of drill cuttings and water based mud (WBM) from both the topholes and lower well sections; and
- Discharge of cement.

The planned drilling will result in various drilling discharges directly onto the seabed and at the sea surface. These discharges have the potential to affect the marine environment (benthos and water column) through both chemical and physical mechanisms. The extent of these discharges has been quantified and the significance of their associated effects assessed in this section. As explained in Section 4.4.2, there is a preference to use CAN-ductors on all wells. However, for any wells where the use of the CAN-ductor proves to be not suitable, conventional tophole sections will be drilled by the Mobile Operated Drilling Unit (MODU) instead.

This section assesses the potential impacts of drilling discharges upon benthic communities and the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA) conservation objectives. A worst-case volume of discharges of drilling all wells (including drilling, optional appraisal and water injection) with conventional tophole sections is considered in this assessment (albeit that this scenario is very unlikely).

10.1 Description and Quantification of Discharges

10.1.1 Mud and Cuttings

Drill cuttings and spent drilling muds will require disposal as part of the planned drilling operation at Cambo. Drill cuttings consist of the chips of crushed rock broken off by the drill bit as it extends the wellbore and therefore vary in nature depending on the characteristics of the rock layers present and the drill bit used. Generally, they consist of particles ranging in size between very fine clay sized particles (< 2 µm) to coarse gravels (> 30 mm) (Neff, 2005). As described in Section 4.4.3, the Cambo wells will be drilled using WBM and/or low toxicity oil-based mud (LTOBM) systems, comprising a base fluid of seawater or low toxicity oil within which clays and other mineral weighting agents such as bentonite are suspended. Additional chemical additives, including organic polymers such as glycol, may also be used to maintain the optimal performance of the mud.

Assuming no CAN-ductors are used as a worst-case scenario, the first two sections will be drilled open hole and the cuttings will be discharged near the seabed. The mud system for these two top sections of the well (36" and 17½") will consist of seawater with high viscosity

bentonite sweeps to clean out the borehole and the frequency and volume of the sweeps will be determined by the hole conditions.

Following the drilling of the two conventional top-hole sections, two successively deeper 12¼" and 8½" sections will be drilled with a full WBM or LTOBM system (Section 4.3.3). Mud and cuttings from the deeper sections will pass through a mud recovery system allowing reuse of as much of the drilling mud as possible. If a WBM system is used, all cuttings and spent WBM would eventually be discharged to sea.

If a LTOBM system is used, any contaminated cuttings will be returned to the MODU and either contained and shipped to shore for appropriate treatment and disposal. Alternatively, they will be thermally treated offshore to remove the oil and discharged to sea, provided they contain less than 1 % oil by weight after cleaning (Section 4.4.3). As mentioned in Section 4.4.3, it is estimated that for all 14 wells, a total of up to 21,384 tonnes of cuttings and 62,268 tonnes of WBM will be discharged representing the theoretical worst-case discharge scenario.

10.1.2 Payzone and Associated Drilling Fluids

Cuttings generated when drilling through the reservoir formation may become contaminated with the hydrocarbons. These are commonly referred to as 'payzone cuttings'. If this section is drilled with WBM, it is proposed that the payzone cuttings will be discharged to sea under an Oil Pollution Prevention and Control (OPPC) permit, which is common practice on the UK Continental Shelf (UKCS). This discharge will be monitored. Should the cuttings contain more hydrocarbons than permitted, then they will be contained and shipped back to shore for appropriate treatment and disposal. If the payzone is drilled with a LTOBM system, the cuttings will be treated in the same way as all other LTOBM cuttings, as described in 10.1.1 above.

10.1.3 Cement

The two well design options have a direct impact on the amount of cement that will be discharged, depending on whether a CAN-ductor is used for the tophole section of the well, or if the well is drilled with conventional tophole sections instead. The worst-case scenario, with regard to cement discharges, will be for the conventional well design, i.e. without a CAN-ductor, and thus this scenario has been assessed in this chapter.

It is anticipated that up to 41.1 m^3 of cement slurry may be discharged in this fashion per well. As explained in Section 4.4.4.2, no cement returns are expected from the deeper well sections under normal operational conditions. The only potential discharge during this part of the cementing operations would be from an unplanned vent, such as an aborted cement job due to technical or mechanical failures. If for any reason cement is circulated back to the MODU, it would need to be discharged to sea before it solidifies. No unmixed cement will be discharged overboard.

10.2 Impacts from Water Based Muds (WBM) and Cuttings Discharges

10.2.1 Physical Extent of Discharges

Cuttings dispersion modelling has been undertaken for nine production wells, and four water injection wells and an optional appraisal well, considering three different scenarios, to estimate the physical extent of the discharged drill cuttings (Fugro, 2025h; Table 10.1).

Table 10.1: Modelling scenarios

Modelling Scenario	Explanation
Well B	Well with one sidetrack off each of lower sections
Well C	Standalone well with two sidetracks off each of lower sections
Well D	Well re-spud - two tophole sections only

Prevailing hydrological current conditions to inform the modelling were sourced from the Massachusetts Institute of technology general circulation model (MITgcm). The model simulates circulation at a regional scale and has been validated against current oceanographic datasets.

The potential dispersion of the drill cuttings has been predicted using an advection - dispersion model, whereby two 'release' scenarios were modelled as follows:

- Scenario 1 (Planned release)– Estimation of (maximum) anticipated thickness of cuttings deposited on the seafloor at increasing distances from the well location; and
- Scenario 2 (Spread release) – Estimation of (maximum) anticipated extent of cuttings deposited on the seafloor taking into account the variability associated with the tidal cycles and residual currents.

For Scenario 1, the simulated drill cuttings release was conducted in accordance with the planned drilling schedule providing the best estimate of the cuttings deposit thickness on the seafloor at increasing distances from the well location. However, as the conditions at the actual time of drilling will differ from those considered at the time of modelling, this scenario will not capture the potential (full) range of directional spreading of the deposits, because the zone of deposition will be influenced by the magnitude and orientation of the currents in the selected modelling period.

For this reason, Scenario 2 was run to account for the variability associated with the tidal cycles and residual currents. Scenario 2 considers that the drill cuttings are released continuously during a longer period of 25 days. This approach ensures that the predicted dispersion pattern considers the temporal variability of the local water currents both in terms of intensity and orientation and provides the best estimate for the maximum directional spreading of the drill cuttings away from each well location. Note however, that this approach will underestimate the deposit thickness, as the simulated drill cutting releases are being dispersed over a wider area.

To reduce the number of numerical analyses, the simulation was based on the drilling schedule for one production well. Well P10 was selected, as it represents the worst-case scenario with

the largest cuttings volume. A conservative estimate for the total thickness of the deposits, corresponding to the drilling of all the production wells, is then estimated by transposing and adding the simulation results from well P10 to the other well locations. An overall cumulative thickness can then be estimated.

The planned release scenario for well P10 (Figure 10.1) indicates dispersion of > 30 cm drill cuttings up to approximately 10 m to the southwest of the drill centre, whereas cuttings > 10 cm are projected up to 25 m to the southwest.

The spread release scenario (Figure 10.2) indicates dispersion of > 30 cm drill cuttings up to approximately 20 m to the west-south-west of the drill centre, whereas cuttings > 10 cm are projected up to approximately 30 m to the west-south-west.

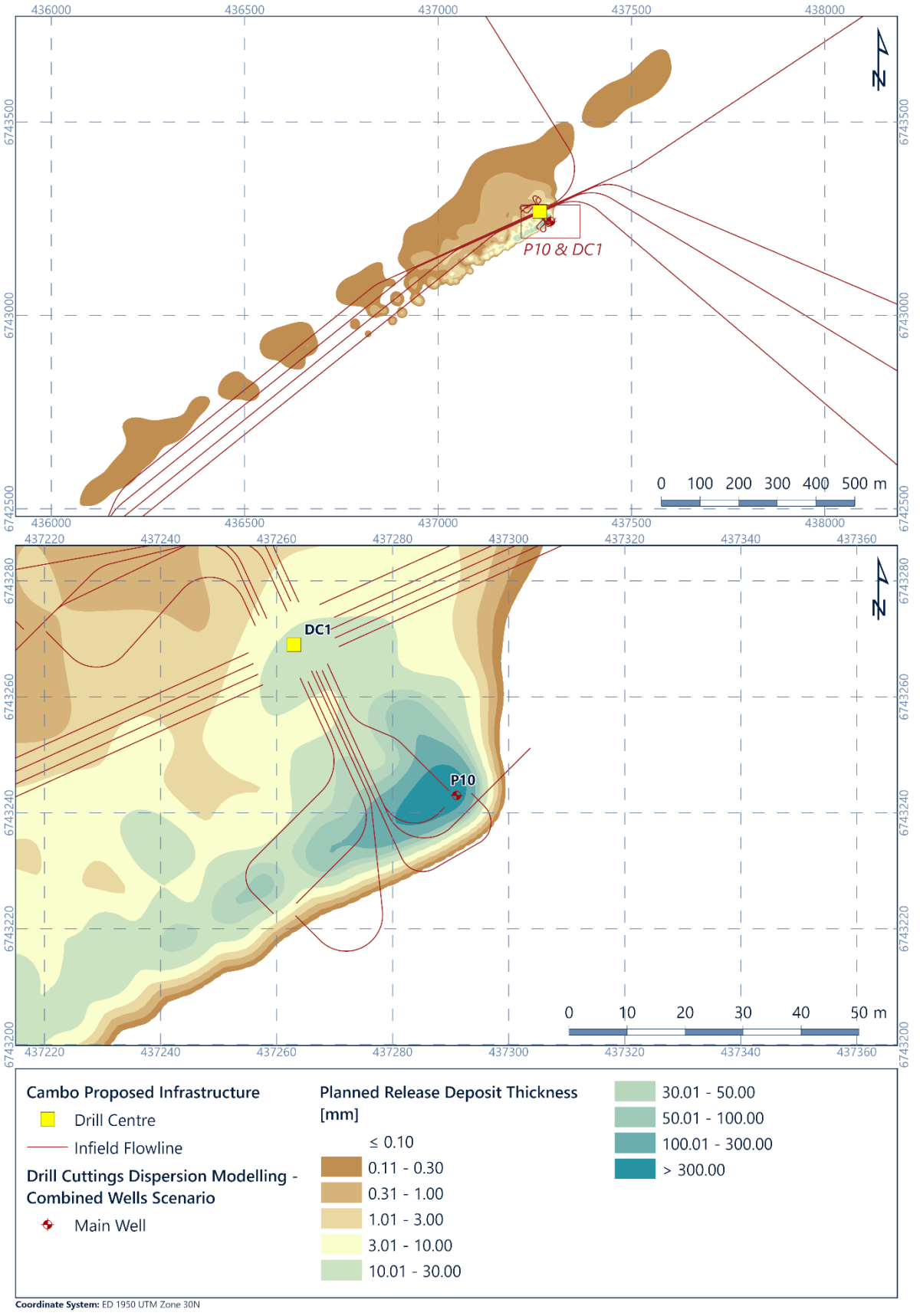


Figure 10.1: Planned release scenario for P10 well

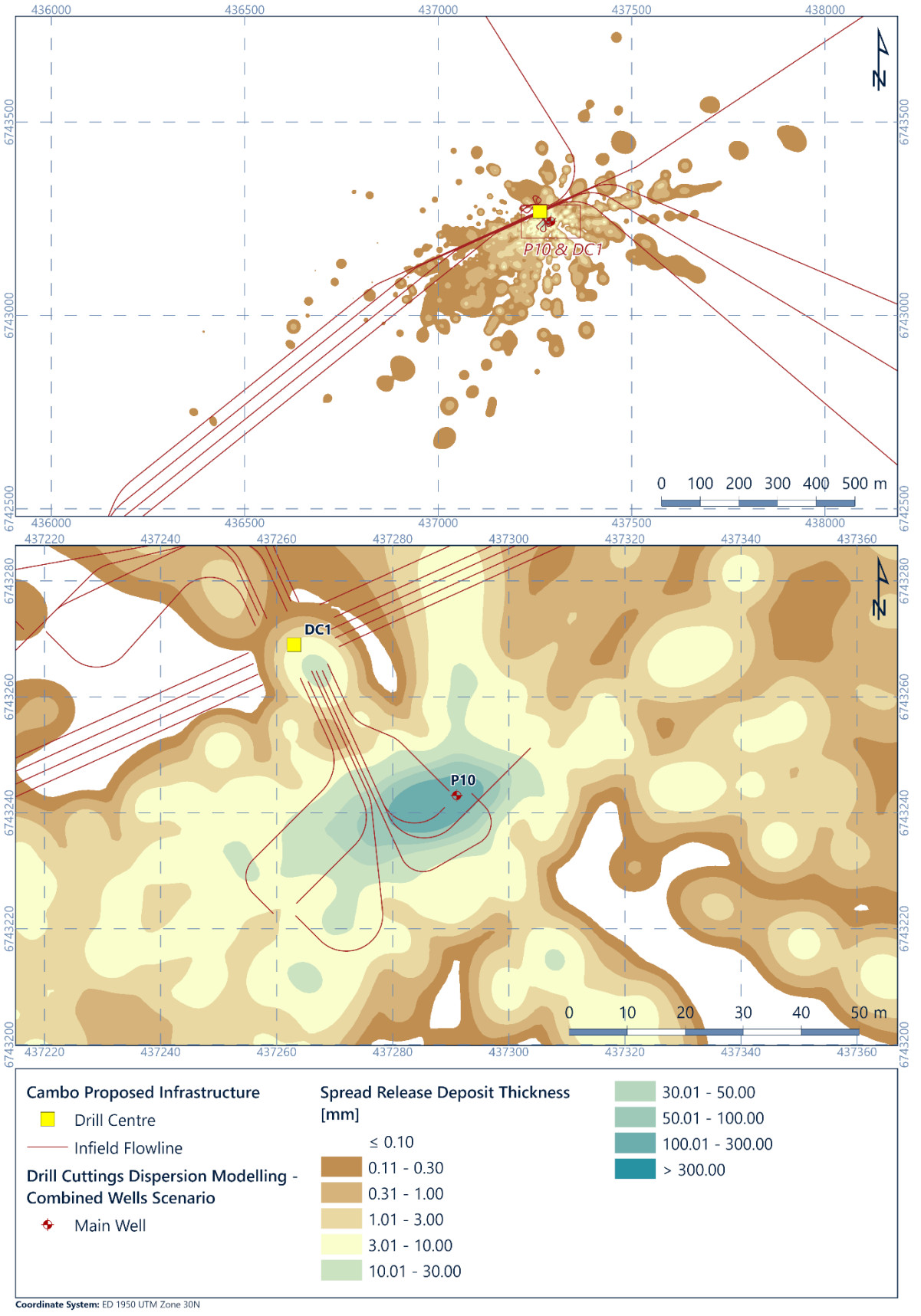


Figure 10.2: Spread release scenario for P10 well

10.2.1.1 Planned Release Model Outputs for Combined Wells

The modelling results for the Planned Release scenario (maximum thickness) indicate that the maximum area where a measurable change in seabed deposits is observed (i.e. thickness of 5 mm and above) is predicted to cover an area of approximately 0.188 km^2. Significant deposits, of a thickness above 50 mm, are predicted to cover an area of approximately 0.017 km^2 (Table 10.2) and are restricted to within 200 m of well locations.

Table 10.2: Topographical metrics of combined cuttings piles for the planned release scenario

Thickness [mm]	Area [km^2]	Area Within 200 m of Wells [km^2]
≤ 5.0	51.71	0.922
5.1 - 10.0	0.050	0.042
10.1 - 20.0	0.029	0.029
20.1 - 50.0	0.023	0.023
50.1 - 100.0	0.008	0.008
100.0 - 200.0	0.004	0.004
200.1 - 300.0	0.002	0.002
300.1 – 1,006.8	0.003	0.003
Total	**51.83**	**1.03**
Total > 5 mm	**0.188**	**0.111**
Total >50 mm	**0.017**	**0.017**
Maximum Thickness (m)	-	**1.007**

The modelling results show that the mud and cuttings are mainly transported along a west-south-west and northeast direction. Due to deep water and various masses of water at the Cambo location moving in multiple directions (as explained in section 5.3.1) the discharged mud and cuttings particles are expected to initially move to the northeast (North Atlantic water mass) and then disperse to the west-south-west (North Atlantic Deep Water mass) as they sink through the water column. The larger coarser particles, which have the highest settling velocity, will travel much shorter distances in comparison to the finer particles. Therefore, the larger particles generally settle closer to the release point with the finer particles being transported and settling onto the seabed at further distances.

Figure 10.3 shows the maximum cuttings deposition thickness at the modelled well locations to be approximately 1 m in height, quickly reducing to a thickness of < 1 cm nearly 200 m from each well location. Figure 10.4 presents the maximum anticipated extent of deposition for all wells.

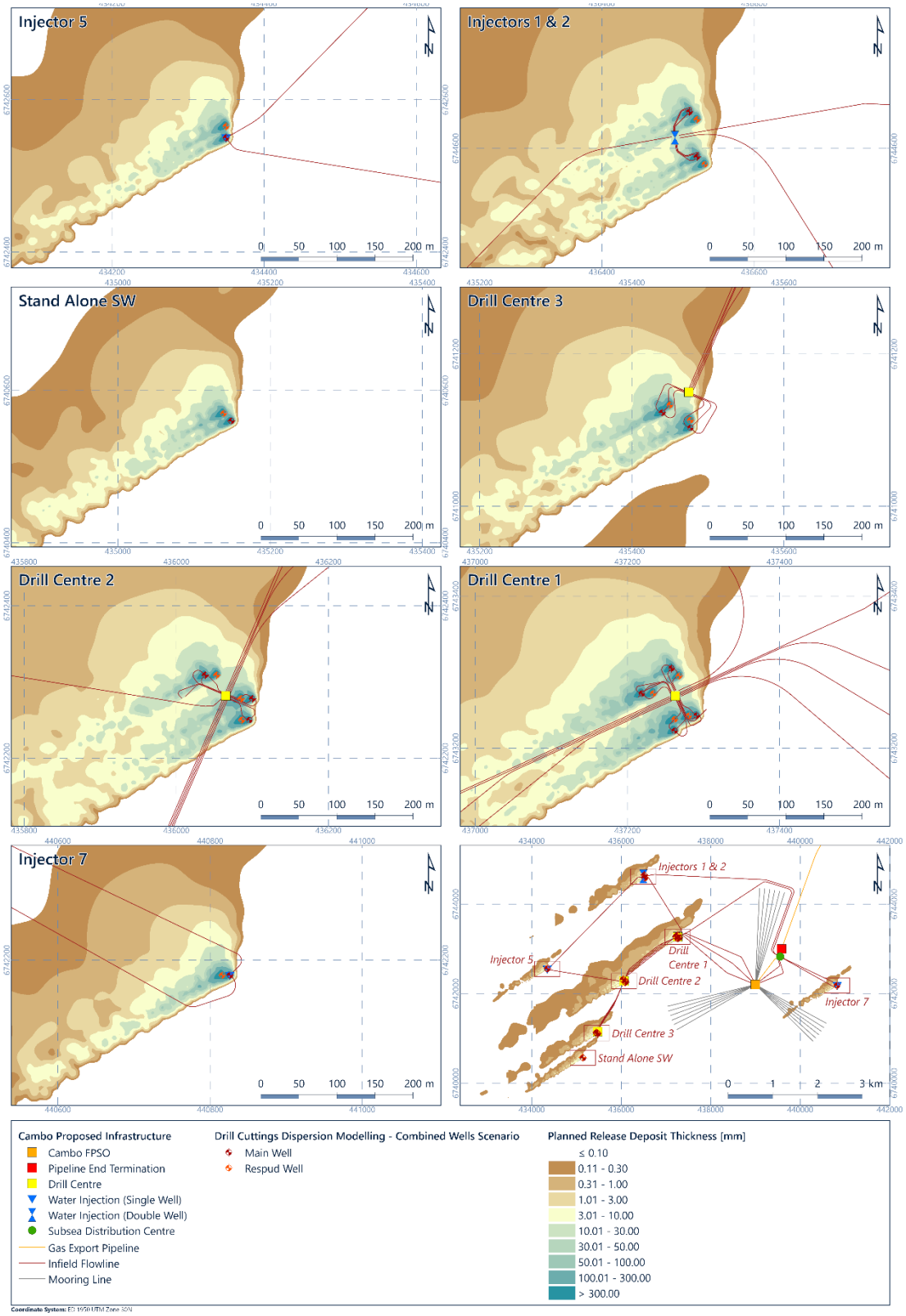


Figure 10.3: Maximum Anticipated Thickness of Deposition for All Wells (Planned Release Scenario)

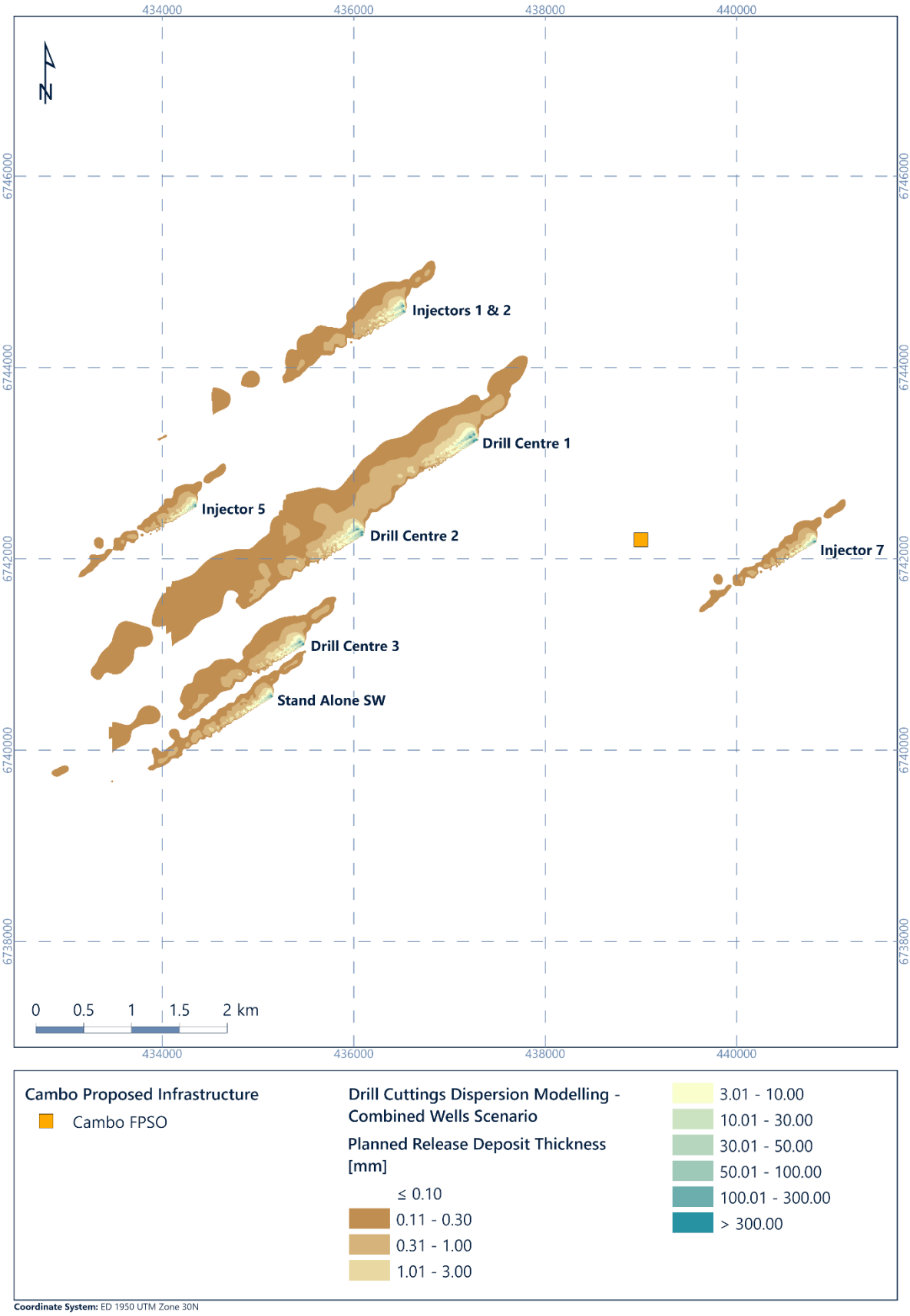


Figure 10.4: Maximum anticipated extent of deposition for all wells (planned release scenario)

10.2.1.2 Spread Release Model Outputs

The modelling results for the Spread Release scenario (maximum extent) indicate that the maximum area where a measurable change in seabed deposits is observed (i.e. thickness over 5.0 mm and above) is predicted to cover an area of approximately 0.117 km^2. Significant deposits, of a thickness above 50 mm, are predicted to cover an area of approximately 0.008 km^2 (Table 10.3) and are restricted to within 200 m of well locations.

Table 10.3: Topographical metrics of combined cuttings piles for the spread release scenario

Thickness [mm]	Area [km^2]	Area Within 200 m of Wells [km^2]
≤ 5.0	59.12	0.915
5.1 - 10.0	0.071	0.071
10.1 - 20.0	0.028	0.028
20.1 - 50.0	0.011	0.011
50.1 - 100.0	0.004	0.004
100.0 - 200.0	0.003	0.003
200.1 - 300.0	0.001	0.001
300.1 – 1,006.8	0.000	0.000
Total	**59.24**	**1.032**
Total > 5 mm	**0.117**	**0.118**
Total > 50 mm	**0.008**	**0.008**
Max Thickness (m)	-	**0.317**

Figure 10.5 and Figure 10.6 illustrates the predicted deposition of drill cuttings around each well location and the maximum anticipated extent of deposition for all wells respectively. Maximum thicknesses of cuttings deposition under the Spread Release scenario are forecast to be approximately 0.32 m quickly reducing to a thickness of < 1 cm to within approximately nearly 200 m from each well location.

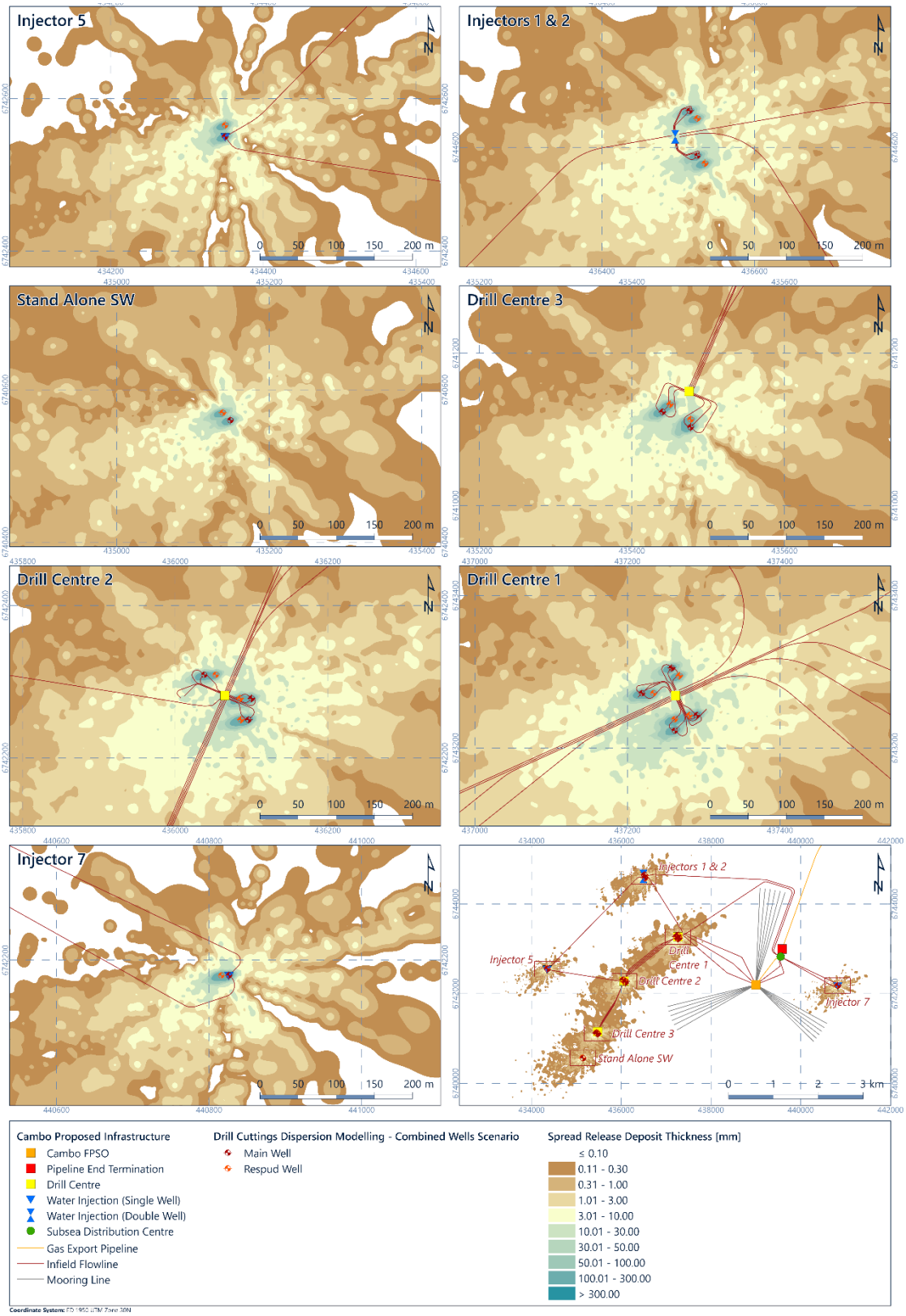


Figure 10.5: Maximum anticipated extent of deposition for all wells (spread release scenario)

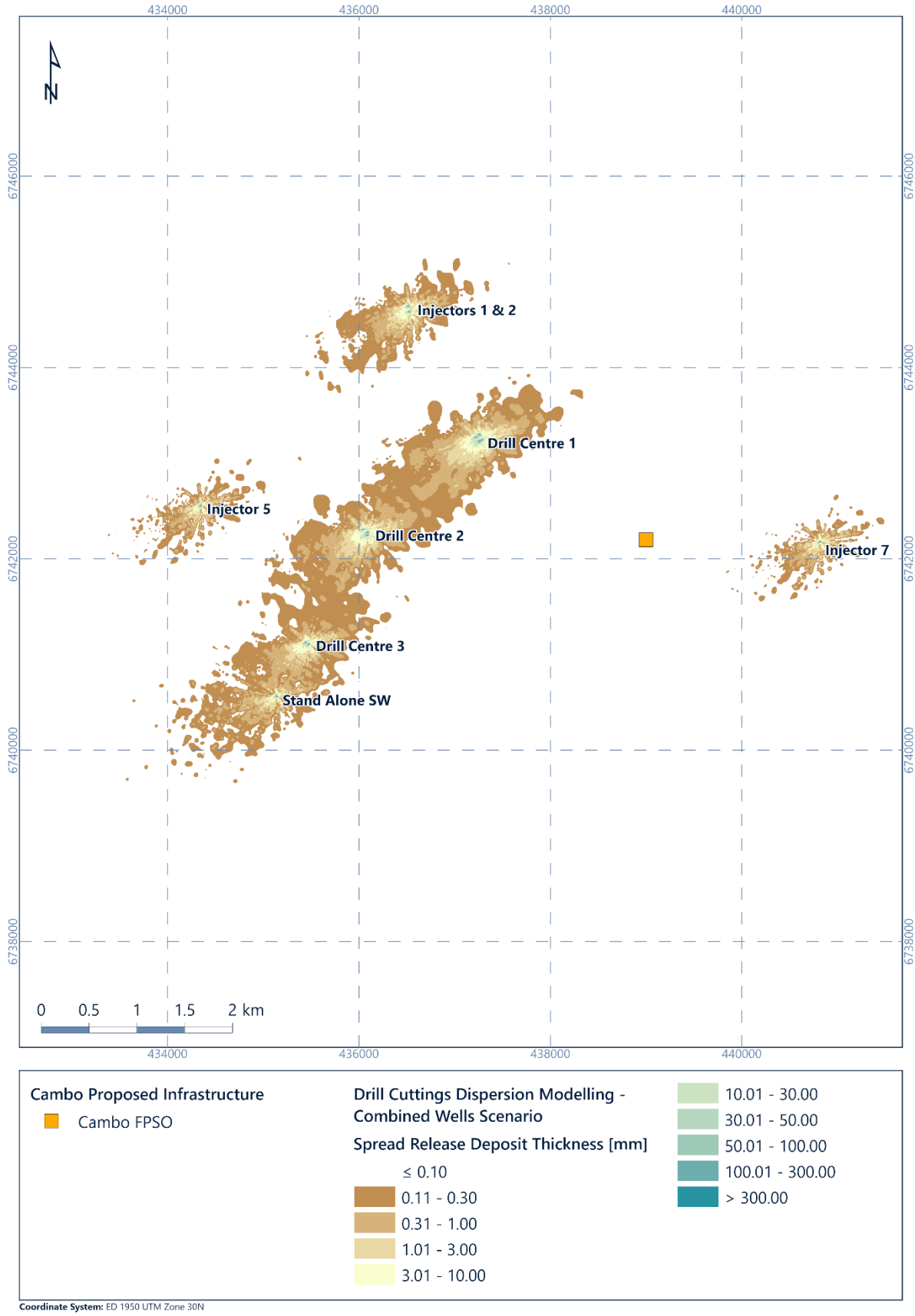


Figure 10.6: Maximum anticipated extent of deposition for all wells (spread release scenario)

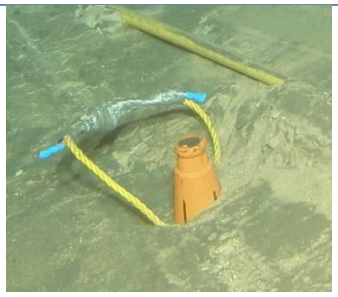
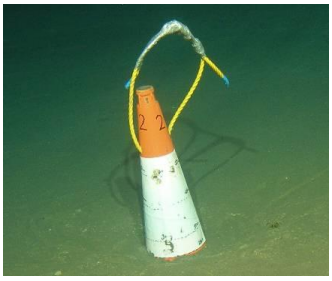
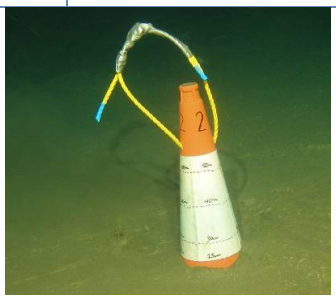
10.2.1.3 Proximity to Protected Areas

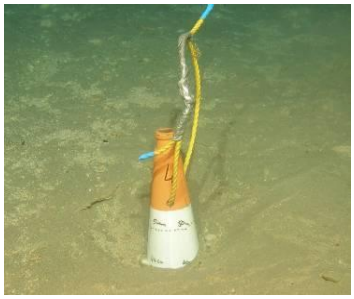
The closest protected area to the drilling locations is the Faroe-Shetland Sponge Belt NCMPA, which lies 16 km to the south (Figure 5.18). The predicted southwest-northeast distribution patten of drill cuttings over the wider area (Figure 10.4 and Figure 10.6) is perpendicular to the direction of the NCMPA indicating limited or no transport of significant quantities of drill arisings towards the NCMPA. Significant thicknesses of 50 mm or more are not predicted to encroach within 14 km of the Faroe-Shetland Sponge Belt NCMPA.

10.2.1.4 Comparison to Other Drill Cuttings Studies in the Area

Previous surveys in the region have validated model predictions. For example, up to approximately 60 cm of accumulated material was previously observed, up to 20 m away to the southwest of the Cambo 4 well (Table 10.4; Fugro, 2011b). This is broadly consistent with the current modelling results.

Table 10.4: Approximate cuttings and cement accumulation for all visible cones and distances from Cambo 4 well

Transect	Cone Number	Distance from Well Centre [m]	Heading [°]	Material Accumulation [cm]
Southwest	1	18.55	212	60
			30	60
Southwest cone 1: Pre-drill 212°		 Southwest cone 1: Post-drill 212°		Southwest cone 1: Post-drill 30°
Transect	**Cone Number**	**Distance from Well Centre [m]**	**Heading [°]**	**Material Accumulation [cm]**
Southeast	2	16.50	141	24
			320	22
Southeast cone 2: Pre-drill 145°		 Southeast cone 2: Post-drill 141°		 Southeast cone 2: Post-drill 320°
Northeast	3	4.81	170	Assumed to be >70

<table>
<tr><th>Transect</th><th>Cone Number</th><th>Distance from Well Centre [m]</th><th>Heading [°]</th><th>Material Accumulation [cm]</th></tr>
<tr><td colspan="2">
Northeast cone 3: Pre-drill 170o</td><td colspan="3">No photographs available of the northeast cone post drilling, assumed buried completely underneath the cuttings and cement discharges</td></tr>
<tr><td rowspan="2">Northwest</td><td rowspan="2">4</td><td rowspan="2">14.92</td><td>296</td><td>40</td></tr>
<tr><td>160</td><td>42</td></tr>
<tr><td colspan="2">
Northwest cone 4: Pre-drill 300 º</td><td>
Northwest cone 4: Post-drill 296 º</td><td colspan="2"> 
Northwest cone 4: Post-drill 160º</td></tr>
</table>

Pre- and post- drilling monitoring at the nearby Rosebank site (Block 213/27; SERPENT, 2009) found that the seabed within 40 m of the drilled well, was covered by a uniform coverage of drill cuttings material with no visual evidence of the natural seabed, although the depth of coverage was not recorded. Areas of darker sediment 'patches' were identified between 40 m and 90 m from the well, interspersed with areas of underlying natural sediments. No visible evidence of drill cuttings deposition was found at distances beyond 100 m from the drill centre in all.

The SERPENT research was part of nine other ROV surveys undertaken at drilling sites in the Faroe-Shetland Channel and Norwegian sea as part of a 5 year monitoring programme. Water depths at these sites varied between approximately 400 m and 1,750 m. Although there was some variation between sites generally speaking, cuttings deposition was very thin and some of the natural seabed was visible at distances greater than 100 m from the drilling location. No evidence of discharge was observed at distances > 200 m from the drilling locations (Fugro, 2025i; DeepOcean, 2025).

This general pattern largely corresponds with the results from the proposed Cambo cuttings modelling. For each scenario a large percentage of the cuttings and mud volume is predicted to be deposited within 100 m of each well location (Figure 10.3 and Figure 10.5). The volume of deposited material distributed on the predominant current (North Atlantic Deep Water mass) drops rapidly to submillimetre levels over the 200 m threshold from each drilling centre location to the southwest and below this threshold up to 50 m away in any other direction.

10.2.2 Effects on Benthic Communities

Considerable data have been gathered from studies into the effects of drill cuttings and WBM on benthic communities, conducted at various sites on the UKCS and worldwide as part of academic research and general environmental monitoring of the oil and gas industry (e.g. DTI, 2001; Jones et al., 2012; Neff, 2005; OSPAR, 2007). This work has led on from earlier and ongoing studies into the long term persistence and effects of oil base mud (OBM) contaminated cuttings, the discharge of which is generally no longer permitted due to concerns over environmental disturbance. This work has led to a broad consensus on the potential effects that discharged cuttings and associated fluids can have on benthic organisms and communities.

10.2.2.1 Physical Impacts on Benthic Communities

The primary impact identified with regard to WBM cuttings is the direct smothering effect of burial by material discharged as it settles on the seabed (Neff, 2005; OSPAR, 2007). Any cement discharged at the seabed will add to this impact, resulting in very similar effects. The threshold for deposition of 50 mm of material (even for a single event) has been used for assessing significant effects, due to the medium to high sensitivity of sponges and corals to physical change (to another seabed type) and changes in siltation rates (Tillin et al., 2010; Tuttle & Donahue, 2022; Tyler-Walters et al., 2023).

Vulnerability to the impact caused by cuttings and cement discharges varies between different benthic groups, depending on their physiology and ecology, and some species (such as sessile species among others) are likely to be more sensitive than others. For example, in the case of burrowing organisms, which feed on subsurface sediments, many such species are capable of burrowing up through deposited sediment ranging from 10 mm to 300 mm in thickness to live at the new sediment surface (e.g. Bromley, 2012; Kukert, 1991; Maurer et al, 1979). However, it is unlikely that whole communities would survive burial under more than a few centimetres. For the purposes of this assessment, it is assumed that all benthos in the areas covered > 300 mm of cuttings deposits will be lost over a medium to long time period (i.e several to ten or more years).

A study on the recovery of deepwater megafaunal assemblages (sponges, cnidaria and echinoderms) from hydrocarbon drilling disturbance at the Laggan Well in the Faroe-Shetland Channel (Jones et al., 2012) observed partial recovery of deepwater megafaunal density and diversity after 3 and 10 years, except for very close to the well location where densities and diversity were still reduced. In fact, few megafauna were observed in the area remaining completely covered in drill cuttings, even after 10 years. It should be mentioned that some of the taxa observed at the Laggan well included the sponge *Stylocordyla borealis* and *Chondrocladia* sp., also observed in the Cambo area in 2025. These two species did not show any notable change in average density in deep waters (> 650 m of water depth moving away from the well centre; Jones et al., 2012).

An Oslo and Paris Commission (OSPAR) review of environmental monitoring results from the United Kingdom, the Netherlands and Norway concluded that the effects of WBM cuttings discharge on the seabed fauna tend to be very subtle or undetectable. Any disturbance of the fauna typically only occurs within 50 m from single well locations, although the presence of drilling material at the seabed is often detectable chemically at distances beyond this (OSPAR, 2007).

In addition to the smothering effects described above, increased concentrations of suspended particles in the water near the seabed may also cause damage to feeding and respiratory organs, causing metabolic stress and reducing growth, and also affecting reproductive and survival rates. This, for example, has been demonstrated in scallops and other bivalves (Bechmann et al., 2006; Cranford et al., 1999). Larger individuals are generally more resistant to elevated levels of suspended solids in the water column, and some species are likely to be more sensitive than others. It should also be noted that effects related to increased suspended sediment levels will mostly take place close to the well location and for a limited time period.

There is also limited evidence available indicating that rock material brought up from within wells has a lower nutrient value than natural sediments. This may lead to increased mortality due to starvation in affected communities (Trannum et al., 2009). Alteration of the substrate by drilling discharges can also affect the settlement of benthic organisms that subsequently colonise the area (Trannum et al., 2009).

Evidence from long-term monitoring at other wells drilled West of Shetland at the Laggan field (Jones et al., 2012), indicate that recovery of megafaunal assemblages in the wider area will be noticeable after a few years, but that full recovery of megafaunal assemblages in areas directly affected by cuttings will be slower and may take > 10 years.

As mentioned in section 5.4.1.1, glass sponges were reported along the Cambo GEP route and Cambo infield FPSO site. However, the qualifying criteria (habitat and ecological function) for the OSPAR threatened and/or declining habitats 'Deep-sea sponge aggregations' or 'Coral gardens' were not met, hence the presence of these habitats was ruled out (Fugro, 2025a).

Seabed sediments within and around the Cambo field are representative of the national important Scottish Priority Marine Feature (PMF) 'offshore subtidal sands and gravels' habitat and are judged to be of '**High**' receptor value accordingly. Sand and gravel sediments are widely distributed across the region (Tyler-Walters et al., 2016). The spatial extent of the effects of the deposition of drill cutting discharges will be highly localised and are not expected to give rise to any cumulative effects with any other project or activity. Mobile sediment fauna will be able to unbury themselves if covered in light accumulations of sediment or relocate to preferred feeding depths if buried. Individuals of sessile species, however, may be lost under thick deposits but at the wider community scale, such losses may be comparable to natural variability, for instance due to predation. Seabed recovery is likely to occur over the medium to long term (10 years) based on observations of the effects of drill cutting discharges

elsewhere. In this respect, effect magnitude is judged to be '**Minor**' on a '**High**' value receptor. Effect significance is thus '**Minor adverse**' and overall not significant.

Drill cutting discharges are not forecast to significantly affect the features for which the Faroe-Shetland Sponge Belt NCMPA is designated. Consequently, the conservation objectives for this site are not expected to be affected.

10.2.2.2 Chemical Impacts on Benthic Communities

In addition to the physical effects described above, any discharged chemicals may also result in toxicity effects. The constituent chemicals used in both the WBM itself and additional drilling chemicals are generally highly water soluble and show low persistence, toxicity and likelihood to be incorporated into the tissues of marine organisms. Weighting agents found in drilling muds, such as barite, may contain elevated levels of barium and other metals, which will typically be higher than those found in naturally occurring seabed sediments. However, the metals and metal salts associated with barite, clay, and cuttings particles are not readily bio-accumulated by animals living in close association with cuttings piles and the metals are not passed efficiently through marine food chains (Leuterman et al., 1997; Neff, 1987; Neff et al.,1989; URS, 2002). For example, upon ingestion or adhesion to epithelial surfaces, metals present in cuttings material are often not assimilated into the organism's tissues. Instead, they remain compartmentalised as insoluble, inert matter—likely in the form of original barite particles (Jenkins et al., 1989). Therefore, any toxic effects of WBM associated with cuttings discharge have generally been deemed to be negligible (Neff, 2005; OSPAR, 2007).

WBMs may also occasionally contain some organic components such as glycol. The discharge of such substances onto sediments can lead to organic enrichment, whereby increased levels of microbial activity feeding on the organic matter results in oxygen depletion within the affected sediments. The presence of cuttings material on the seabed also prevents the flow of oxygen and nutrients to the affected areas. This oxygen depletion and associated disruption of nutrient flow can be sufficient to reduce the abundance and diversity of the benthos (Neff, 2005; Trannum et al, 2009). Nonetheless, previous monitoring studies around well sites drilled with WBMs have rarely shown any medium to long term disturbance of benthic infauna (at a community level) detectable beyond 50 m (Neff, 2005; OSPAR, 2007). Moreover, these types of additives will only be present in the drilling fluids for the deeper well sections, that will be discharged from the sea surface. The dispersion modelling study shows that cuttings deposition from these sections will disperse over a wide area, resulting in very low deposition. At such low concentrations it is not anticipated to lead to any oxygen depletion effect, as described above.

As mentioned in Section 10.1.1, any discharges will be discharged to sea under an OPPC permit and will be monitored. Moreover, water depths at Cambo are > 1,070 m and any discharges are subject to mixing and dispersion from tides and currents, further diluting any discharge.

Therefore, the magnitude of effect from chemical input in the water column on benthos is judged to be '**Negligible**' for benthic species. The receptor value is classed as '**Low**' based on the observed fauna, resulting in a '**Negligible**' effect and not significant.

The receptor value of the Scottish PMF 'offshore subtidal sands and gravels' in the area is classed as '**High**', as the habitat is of national conservation value. However, the magnitude of the effect of chemical input on the habitat can be considered to be '**Negligible**', hence the effect significance is **'Negligible**' and not significant.

10.3 Best Practice

All chemicals used for the drilling operations are regulated under the Offshore Chemicals Regulations 2002 (as amended), which aims to replace chemicals with poor environmental characteristics by more environmentally friendly chemicals. Selection of all chemicals that may be used in drilling the proposed well will be based upon both their technical specifications and their environmental performance. The use of all chemicals will be minimised, where practicable

As mentioned in Section 4.4.2, if a CAN-ductor is used, the conductor will already have been cemented into the CAN-ductor onshore, and hence there will be no offshore cementing discharges from the first tophole section. The 21" × 13⅜" casing will be cemented through the CAN-ductor (using ROV monitoring) and this will typically lead to a certain amount of cement being discharged to the seabed immediately around each well with or without the use of a CAN-ductor. However as explained in Section 4.4.4 the projected volume of discharges will be significantly less than in reality. The cementing of the 10¾" × 9⅝" casings for the deeper well sections will be engineered so that the cement will not reach to top of the casing, and thus no cement is expected to be returned to the surface from these sections.

The mud and cuttings from the 12¼" and 8½" sections will pass through a mud recovery system to recover as much of the drilling mud as possible. Once reconditioned, this mud will be used again, thereby minimising the amount of drilling mud used. Eventually all cuttings and spent WBM will be discharged from the drilling rig close to the sea surface, allowing dilution and dispersion over a large area and thereby minimising the overall environmental impact. This is also in line with the regulations and is general practice on the UKCS and elsewhere in the world.

All spent LTOBM will be collected onboard the MODU and will either be contained and shipped to shore for appropriate treatment and disposal or, alternatively, will be thermally treated offshore and disposed to sea. These cleaned cuttings are only allowed to be discharged to sea if they contain less than 1 % of residual oil by weight and will be subject to an OPPC permit.

Finally, the actual mud and chemical usage and discharge volumes will be monitored during drilling operations and subsequently reported to OPRED.

10.4 In Combination, Cumulative and Transboundary Impacts

Oil and gas activity West of Shetland is relatively low, in comparison with the neighbouring northern North Sea. The BP operated Alligin, Loyal, Schiehallion and Foinaven fields are located > 40.5 km to the south of the proposed development footprint.

The proposed Cambo field development lies > 4 km east of the UK/Faroe Island maritime boundary.

As described in the sections above, the effects of the drilling discharges will be limited to within a few hundred metres from the well location. Therefore, no overlap with existing effects, either in in spatial or temporal context are anticipated. Consequently, the potential of cumulative and transboundary effects from drilling discharges is extremely limited, and therefore considered to be not significant.

10.5 Conclusion

Environmental effects due to discharges of drill cuttings and cement on the seafloor at Cambo are forecast to be '**Negligible**' to '**Minor adverse**' and, and therefore not significant. No specific mitigation measures in respect of drilling discharges are therefore considered necessary.

Best practice and industry regulation in respect of choice of chemicals and treatment and disposal of drilling muds will be applied. Activities will be subject to prior permitting.

The impacts assessed here are based on a worst-case modelling scenario assuming that all tophole sections are to be drilled. In the case that CAN-ductors are used, then this will reduce the overall extent, thickness and impact of drill cuttings.

11. Produced Water and Marine Discharges

This Section addresses issues and concerns associated with the discharge of produced water and ballast water on the marine environment. Both discharges were discussed during the Environmental Issues Identification (ENVID) workshop, informal stakeholder consultation and is part of the National Marine Plan (NMP).

The workshop raised the potential for impacts to arise from the discharge of produced water on benthic and water column communities and for an increase in environmental risk to occur due to the introduction and spread of marine invasive non-native species (MINNS) due to discharges of ballast water.

11.1 Produced Water Discharge

Produced water can be defined as water from the formation which is produced together with oil and gas (OSPAR, 2009c). Produced water may contain residues of reservoir hydrocarbons, as well as chemicals added during the production process, along with dissolved organic and inorganic compounds that were present in the geological formation.

As described in Section 3 (Option Selection), several options were investigated for the treatment and disposal of produced water before the decision was made to clean-up and discharge it to sea. Two key factors were the main drivers for this decision, (i) the potential for reservoir souring and (ii) issues with reservoir injectivity into the weak, consolidated rock associated with the Cambo reservoir.

With regard to the first factor, it was considered that due to the low temperature of the Cambo reservoir it is susceptible to Sulphate Reducing Bacteria (SRB) activity. In addition to this, the Cambo produced water has a high volatile fatty acid content that will provide nutrients to the SRB, resulting in Hydrogen Sulphide (H_2S) generation. As a consequence, the H_2S can be expected to 'sour' the reservoir fluids.

With regards to the second factor, the Cambo reservoir is considered to have specific injection requirements due to the relatively weak, unconsolidated rock. In order to maintain injectivity and pressure support for oil recovery it is preferred that only filtered, treated seawater is injected to reduce the risk of near wellbore fouling and poor operability of produced water re-injection systems. Due to these issues the final decision was taken to clean up and discharge the produced water.

11.2 Treatment of the Produced Water

Sections 3 and 4 (Option Selection and Project Description) present the detail of the rationale for selection of the produced water management approach and proposed treatment process for produced water. A summary of this rationale is provided below.

Produced water will be treated to remove potential hydrocarbon contamination as far is possible prior to discharge to sea.

The treatment process will be designed to treat all of the anticipated water production and reduce the residual dispersed oil content in the produced water to a target concentration of 15 mg/l or less (measured on a monthly average basis) before being discharged to sea. This target concentration is below the Oslo and Paris Convention (OSPAR) recommended performance standard of 30 mg/l limit for oil in produced water, as implemented by the Oil Pollution Prevention and Control Regulations, 2005 (as amended).

When the produced fluids arrive on the Floating Production, Storage and Offloading Vessel (FPSO) from the wells they will be directed into the separation train before being routed to produced water hydrocyclones. At this stage reject oily water (approximately 2 % of the oily water feed to the hydrocyclones), will be returned to the process with the remainder routed to a Compact Flotation Unit (CFU). The CFU further reduces the oil content before the water is routed to produced water transfer pumps. The water is pumped through produced water coolers and discharged overboard, or if required, routed to hull tanks for later processing and disposal overboard within the required specification. Discharge is via a disposal caisson below the water line.

11.3 Produced Water Modelling

Produced water dispersion modelling of discharges at the Cambo Field was undertaken by Fugro (2025g). The modelling was performed using Plumes2.0, developed by the US Environmental Protection Agency. This tool was selected for its ability to represent buoyancy-driven and density-dependent effects, which are particularly relevant in the cold, stratified waters of the Faroe–Shetland Channel. Hydrodynamic inputs were derived from the Massachusetts Institute of Technology general circulation model (MITgcm). Two ambient flow regimes were defined by the model (worst-case and typical). The worst-case scenario indicated residual currents of about 0.05 m/s, representing periods of weak tidal forcing, and the typical-case scenario indicated average currents of about 0.21 m/s.

The simulations distinguished between two stages of plume development. The near-field stage is dominated by jet momentum and buoyancy, where strong entrainment of ambient water occurs. This stage ends when the plume either surfaces or stabilises at a neutral buoyancy level. The far-field stage is then governed by ambient currents and turbulence, with dilution progressing more slowly.

Four discharge release scenarios covering different configurations of depth and orientation of discharge and whether the produced water is initially mixed with utility water or not, were developed (see Section 11.3.2).

11.3.1 Ambient Characteristics

The use of the MITgcm circulation model and a 1 year period data (2012) enabled a model resolution of 3 km in both directions, and 50 depth layers within the vertical plane, with increased resolution towards the surface to resolve the boundary layer processes. The model was validated against current meter data available at several locations and at different times.

The validation consisted of direct comparisons of time series of currents. Model skills were evaluated using a wide range of statistical parameters to measure the agreement between modelled and observed variables including both tidal and residual currents. These include the correlation coefficient, root mean square error and Taylor diagrams. A one-year duration was considered representative of local water current movements throughout the different seasons. The adopted temperature, salinity and velocity profiles are the same as those considered for the drilling discharges modelling study (Fugro, 2025h).

The produced water will be released at shallow depths and because of its higher temperature, will be less dense than the receiving waters. As such, it is considered that the discharge plume will remain close to the sea surface.

As part of this investigation, the modelling considered two situations as follows:

- Near-field mixing in the near field zone; and
- Far-field mixing in the far field zone.

The near-field zone is the area of strong initial mixing that is sensitive to the discharge design conditions. It is defined as the area within which the discharge reaches the surface or when it achieves vertically stability within the water column. Typically, this stage occurs over a matter of minutes.

The far field relates to the area beyond this initial mixing zone and beyond the influence of the initial discharge momentum. Here plume dispersion is largely dependent on ambient current conditions. To assess far field plume dispersion, several model simulations were performed over time periods of up to several hours, using a worst-case (low) water flow rate (based on the lowest recorded flow rate within the 2012 dataset (0.05 m/s)) and a more representative (yearly average) water flow rate of 0.21 m/s. Table 11.1 presents the parameters used in the model scenarios to represent worst-case and average receiving water conditions.

Table 11.1: Worst-case and average conditions of the receiving waters considered in the updated (visual plumes) modelling study

Case	Current Speed [m/s]	Direction [Degrees]	Surface Salinity [psu]	Seabed Salinity [psu]	Surface Temp [°C]	Seabed Temp [°C]	Dispersion Constant α [$m^{2/3}/s$]
Worst	0.05	154	35.16	34.94	9.23	0.34	0.0001
Typical	0.21	154	35.16	34.94	9.23	0.34	0.0003

11.3.2 Discharge Characteristics and Scenarios

Table 11.2 summarises the discharge configurations evaluated across the four simulated operational scenarios, including base-case and optimised designs. Overall, four discharge scenarios were considered to evaluate the influence of caisson geometry, flow composition, and release configuration.

Scenarios S1 and S2 involve Produced Water (PW) discharged through a narrow caisson with a diameter of 203 mm, at a flow rate of 357.7 m^3/h. The base-case design S1 uses a horizontal

release at a depth of 5 m, while the optimised design S2 introduces a 30-degree downward angle and increases the discharge depth to 9 m. For scenarios S3 and S4, the produced water is mixed with utility water prior to release and discharged through a larger, 1,800 mm-diameter caisson at a flow rate of 2,622 m^3/h, at same horizontal/vertical orientations as S1 and S2: base-case scenario S3 adopts a horizontal release at 5 m depth, while the optimised configuration S4 adopts a 30-degree downward angle at 9 m depth. All scenarios share the same discharge orientation, measured relative to the prevailing current, with slightly different temperature and salinity conditions.

Table 11.2: Discharge parameters for the different scenarios

Scenario	Diameter Discharge Caison [mm]	Discharge angle (downwards from horizontal) [°]	Discharge direction (relative to current direction) [°]	Discharge Flow Rate [m^3/hr]	Discharge depth [m]	Discharge Temperature [°C]	Salinity [g/L]
S1 - PW only, base-case design	203	0	75	357.7	5	27	33.6
S2 - PW only, optimised design	203	30	75	357.7	9	27	33.6
S3 - PW + Utility, base-case design	1,800	0	75	2,622	5	33	35.3
S4 - PW + Utility, optimised design	1,800	30	75	2,622	9	33	35.3

11.4 Model Results

Model outputs include a range of predicted dilution factors of produced water at selected distances from the discharge point. These are compared against the OSPAR Recommendation for a Risk Based Approach (RBA) to the Management of Produced Water Discharges from Offshore Installations (RBA Recommendation) which recognises that other potentially hazardous substances other than oil, may be entrained within discharged produced water. It is based on the ratio of the calculated predicted environmental concentration (PEC) and the predicted no effect concentration (PNEC) with an acceptance criterion of a PEC:PNEC ≤ 1 within a specified body of water, as indicative of a discharge that is unlikely to result in significant harm in the marine environment (DECC, 2014a; 2014b). As part of the implementation of the RBA Recommendation in the UK, discharges of produced water may be screened out from further assessment if the whole effluent PEC:PNEC at 500 m from the discharge point is ≤ 1 using generic dilution factors. For discharges of between one and eight million cubic metres per year into receiving waters of over 125 m then the dilution factor required to meet this

screening threshold is 400. It is therefore preferred that the proposed Cambo produced water discharges achieve a dilution of 400 times at a distance of 500 m. Results of the current modelling are compared against this threshold.

11.4.1 Worst-case Scenario

Figure 11.1 shows the depth profiles and the horizontal distances and dilution factors achieved for each simulated plume within the near field following discharge under the worst-case scenario (i.e. low currents). Table 11.3 summarises the worst-case near field plume dispersion behaviours.

The modelling study indicated that discharge configuration exerts a decisive influence on plume behaviour. In all scenarios, the plume is initially buoyant owing to its higher temperature and lower density and tends to rise toward the surface. The near-field dispersion stage concludes once the plume's upper limit reaches the sea surface. At the end of the near-field propagation, the dilution factor was predicted to vary between 3.7 to 134 at distances of between 3.2 to 18.9 m respectively (Figure 11.1).

In the base-case scenario S1, the produced water is discharged horizontally at a shallow depth of 5 m, where its higher temperature relative to the ambient seawater generates buoyancy that drives the plume upward almost immediately. This rapid rise limits the near-field propagation to only 52 secs, with the plume travelling 10 m before reaching the surface. The short entrainment period results in a dilution factor of 41 and a plume diameter of 6.8 m. By contrast, for the optimised scenario S2 the downward release angle and the greater depth of release of 9 m, result in an initial plunging of the plume before buoyancy takes over and the plume rising toward the surface. The discharge configuration simulated in this scenario extends the time of the near-field propagation to 199 secs and nearly doubles the horizontal travel distance to 18.9 m, thereby allowing larger near-field mixing and dilution. At the end of the near-field phase, the dilution factor is forecast to increase to 134, and the plume diameter to 15.1 m, confirming the stronger lateral and vertical spreading achieved. The underlying mechanism is that the downward jet momentum in S2 initially counteracts the buoyant acceleration caused by the effluent's higher temperature, delaying the plume's rise to the surface and prolonging the entrainment phase, whereas in S1 the shallow, horizontal discharge allows buoyancy to dominate almost immediately.

Model results from scenarios S1 and S2 differ greatly from those of S3 and S4, with these latter scenarios exhibiting substantially lower dilution. This reduction is primarily due to the much lower effluent exit velocity, which limits turbulent mixing with the surrounding water during the near-field propagation. However, one must also note that the provided dilutions are expressed relative to the initial discharge: for scenarios S3 and S4, concentrations of produced water constituents in the combined release are reduced by a factor of 7.33 (=2622/357.7) owing to the mixing with utility water discharge within the caisson itself.

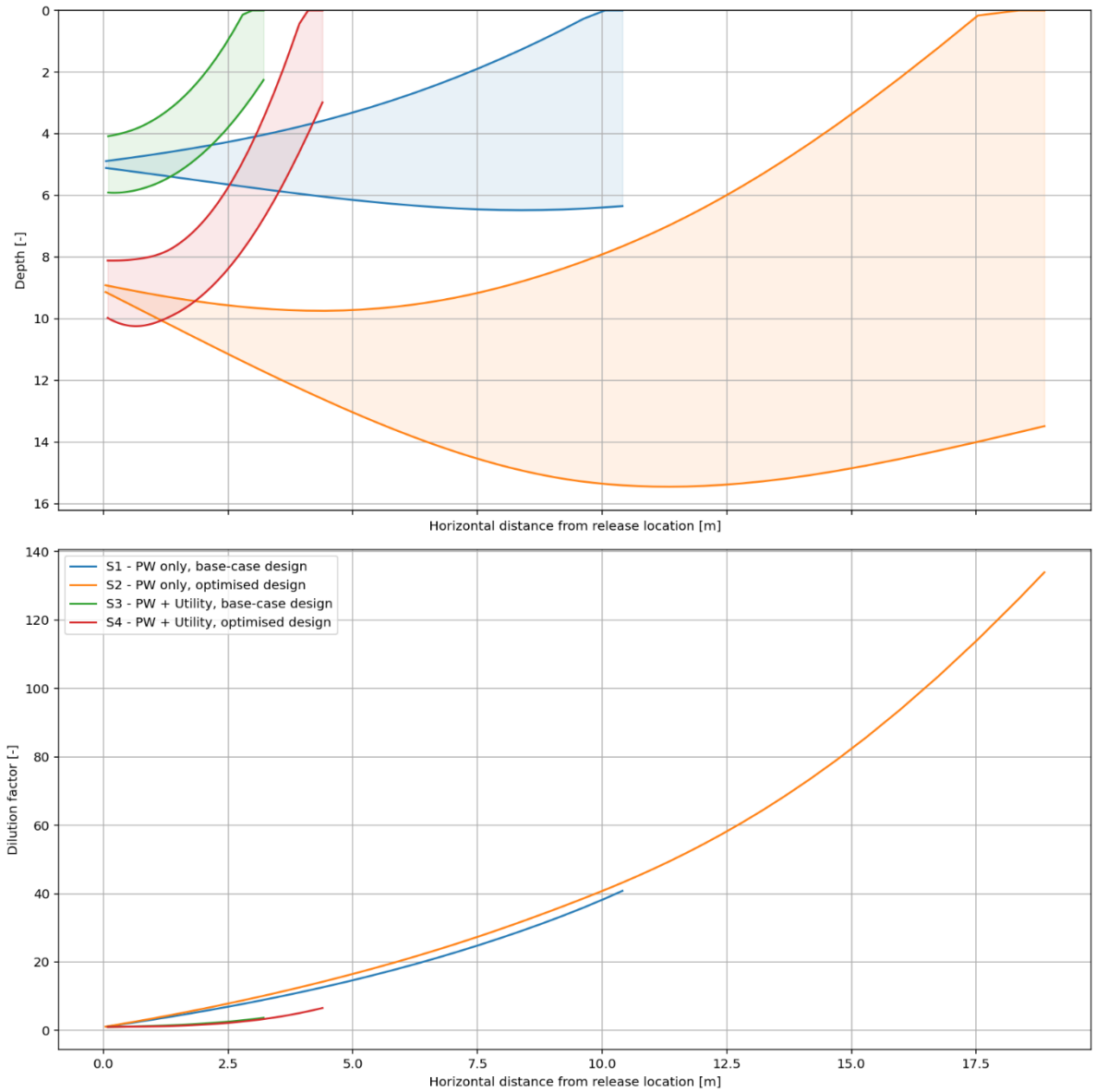


Figure 11.1: Simulated worst-case depth, dilution and distance profiles for produced water discharges at the proposed Cambo field development

Table 11.3: Worst-case current conditions: plume characteristics at the end of near-field dispersion phase

Scenario	Horizontal distance from discharge location [m]	Near-field dilution factor	Plume diameter [m]	Propagation time [s]	Jet velocity [m/s]
S1	10	41	6.8	52	3.07
S2	18.9	134	15.1	199	3.07
S3	3.2	3.7	3.5	20	0.29
S4	4.4	6.6	4.9	38	0.29

Table 11.4 and Figure 11.2 summarise the plume characteristics at different dilution levels for each considered scenario and indicates that under worst-case receiving water conditions, the selected RBA threshold (dilution factor of 400 at 500 m distance) is not achieved.

Table 11.4: Worst-case current conditions: minimum distances for prescribed dilutions

Scenario	Dilution factor	Horizontal distance from discharge location [m]	Plume width [m]
S1	10	3.6	2.0
	25	7.5	4.6
	50	93.0	11.1
	100	285.5	22.9
	250	711.0	57.4
	400	1,053.2	91.8
	1,000	2,124.4	229.6
S2	10	3.2	2.0
	25	7.0	5.0
	50	11.4	8.5
	100	16.5	12.8
	250	348.3	38.9
	400	614.4	62.4
	1,000	1,443.0	156.1
S3	10	202.4	12.9
	25	492.8	32.4
	50	865.8	64.8
	100	1,457.9	129.5
	250	2,805.1	323.8
	400	3,889.6	518.1
	1,000	7,284.3	1,295.3
S4	10	115.5	10.1

Scenario	Dilution factor	Horizontal distance from discharge location [m]	Plume width [m]
	25	365.2	25.6
	50	683.9	51.1
	100	1,189.6	102.3
	250	2,340.4	255.6
	400	3,266.8	409.0
	1,000	6,166.7	1,022.6

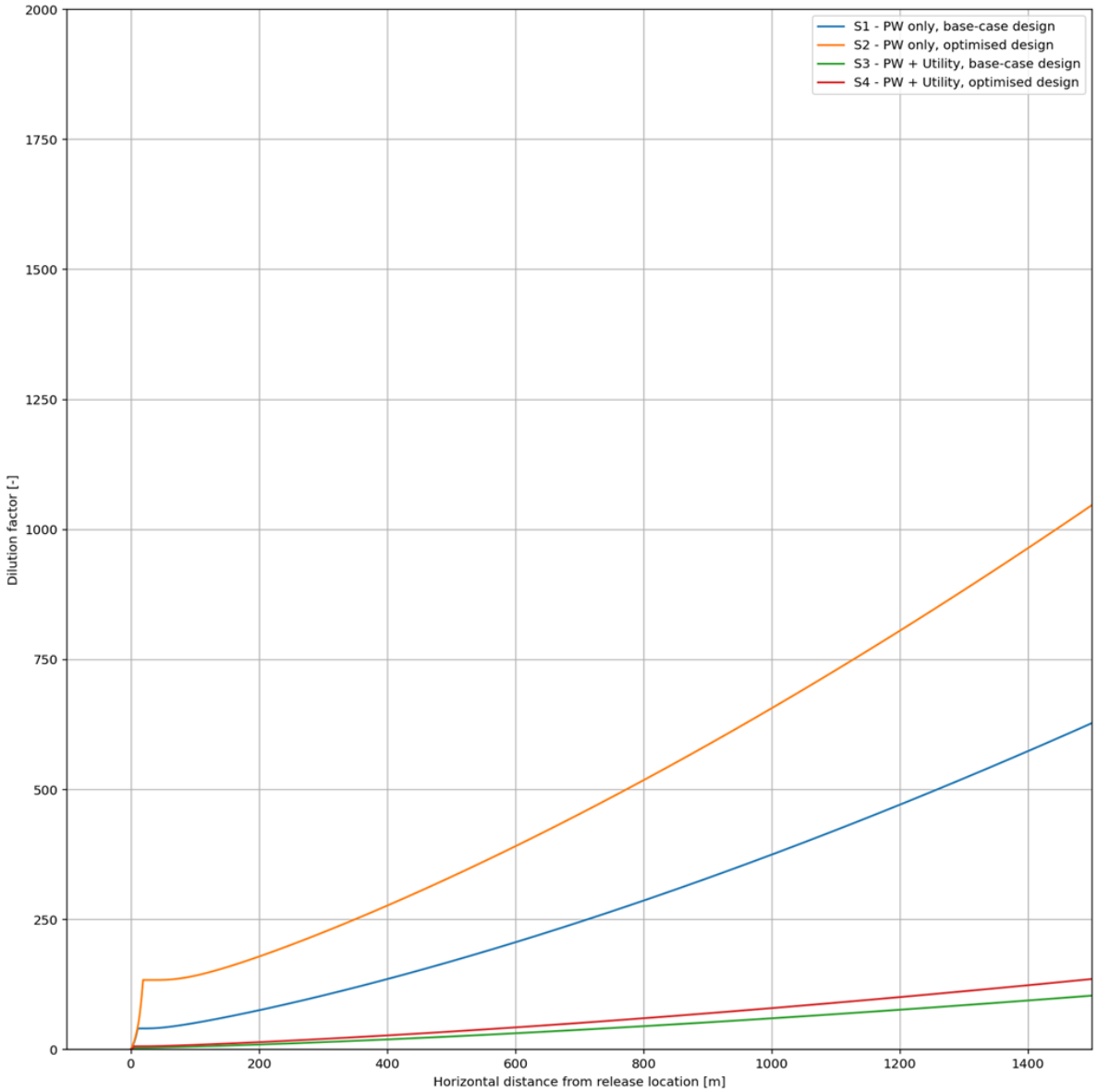


Figure 11.2: Worst-case rates of dilution and distances over which these are forecast to be achieved for simulated discharges of produced water from the proposed Cambo field development

11.4.2 Typical Scenario

Under the annual average scenario, dilutions rates are predicted to be considerably improved. Figure 11.3 presents the depth profiles and dilution characteristics of the simulated produced water discharges under typical environmental conditions within the near field. Table 11.5 summarises the plume characteristics at the end of the near-field propagation for these typical conditions.

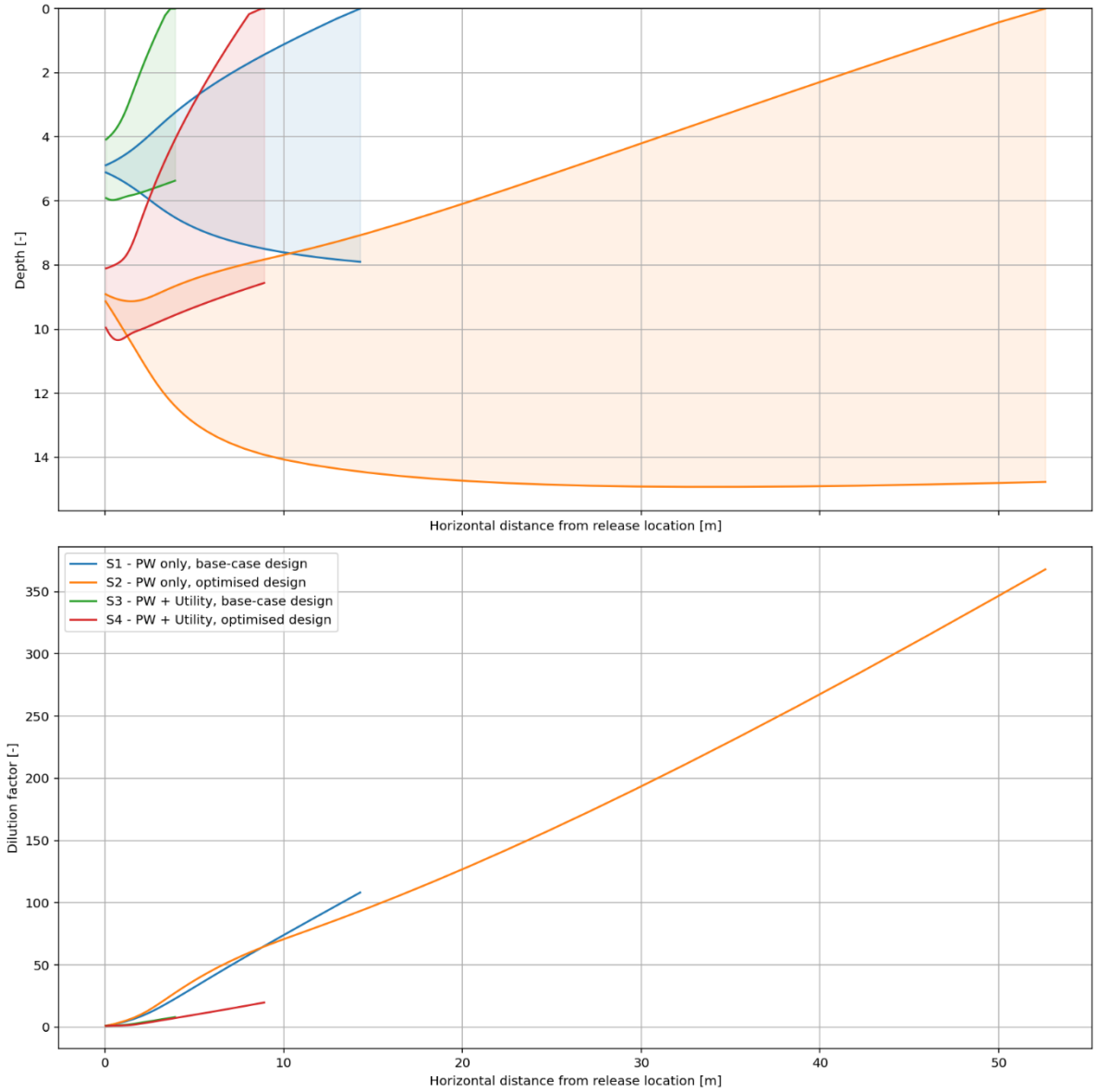


Figure 11.3: Simulated depth, dilution and distance profiles for produced water discharges at the proposed Cambo field development under typical conditions

Table 11.5: Typical current conditions: plume characteristics at the end of near-field dispersion phase

Scenario	Horizontal distance from discharge location [m]	Near-field dilution factor	Plume diameter [m]	Propagation time [s]	Jet velocity [m/s]
S1	14	108	7.9	57	3.07
S2	53	367	14.8	242	3.07
S3	3.9	8.2	5.8	20.7	0.29
S4	8.9	19.8	9.1	48.2	0.29

Table 11.6 summarises the plume characteristics at different dilution levels for each considered scenario. Depending on the scenario, a plume dilution level of 400 is attained at a distance varying from 187 m (S2, most favourable scenario) to ~4,404 m (S3, least favourable scenario).

For scenarios S1 and S2, the dilution achieved during the near-field phase is very efficient which shortens the distances over which certain dilution factors are attained in the far-field phase. In contrast, dilution is less efficient for discharges released under scenario S3 and S4 in average conditions due to the very short near-field phase and faster horizontal spread in the far-field phase with larger ambient currents.

Table 11.6: Typical current conditions: minimum distances for prescribed dilutions

Scenario	Dilution factor	Horizontal distance from discharge location [m]	Plume width [m]
S1	10	2.2	1.8
	25	4.2	3.5
	50	7.1	5.2
	100	13.2	7.6
	250	418.4	25.3
	400	696.5	40.5
	1,000	1,565.2	101.2
S2	10	2.0	1.8
	25	3.7	3.5
	50	6.6	5.3
	100	15.5	7.6
	250	37.7	12.2
	400	187.1	20.8
	1,000	798.8	55.6
S3	10	114.0	9.5
	25	458.8	24.5
	50	892.1	48.9

Scenario	Dilution factor	Horizontal distance from discharge location [m]	Plume width [m]
	100	1,579.7	97.9
	250	3,144.3	244.7
	400	4,403.9	391.4
	1,000	8,346.4	978.6
S4	10	5.0	6.4
	25	169.3	15.4
	50	501.8	31.6
	100	1,016.2	63.2
	250	2,185.5	158.1
	400	3,126.8	252.9
	1,000	6,073.1	632.2

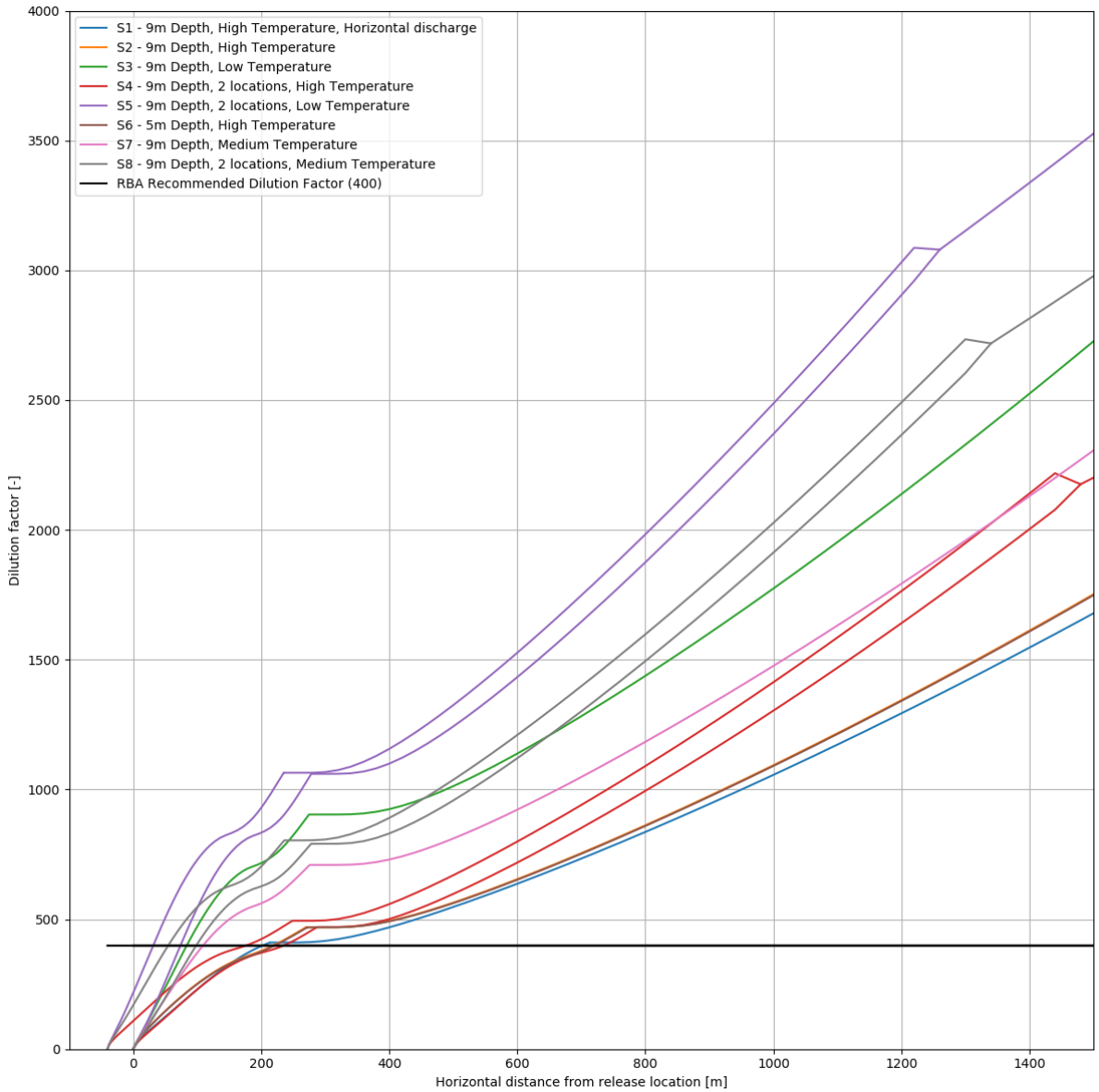


Figure 11.4: Dilution and distances over which these are forecast to be achieved for simulated discharges of produced water from the proposed Cambo field development under typical conditions

11.5 Ballast Water

11.5.1 Marine Invasive Non-Native Species (MINNS)

MINNS encompass a variety of marine plants, fish, microorganisms and invertebrates that are not native to a particular region but have nonetheless been able to establish themselves to the exclusion of native species. Because of this, MINNS pose a threat to local biodiversity, as well as to industry and fishing, if introduced within local marine ecosystems (Bax et al., 2003) and allowed to out-compete native species and proliferate. Several marine invasive non-native species have been reported at West of Shetland including the Carpet sea squirt (*Didemnum vexillum*), Japanese kelp (wakame), the wireweed (*Sargassum muticum*), orange ripple bryozoa, Acorn barnacle (*Elminius modestus*) and others (Marine Directorate, 2025b).

The UK implements the International Maritime Organization (IMO) Ballast Water Management (BWM) Convention through the Merchant Shipping (Control and Management of Ships' Ballast Water and Sediments) Regulations 2022. These regulations apply to:

- All UK ships, regardless of tonnage, worldwide; and
- Non-UK ships operating in UK waters, including the Exclusive Economic Zone (EEZ), which covers the West of Shetland oil and gas fields.

MINNS may be introduced at Cambo if any of the Mobile Offshore Drilling Unit (MODU) or FPSO come via international waters. These include via ballast waters and via attachment to fabricated structures such as topsides or survey equipment that are transported and installed and used on site.

Under both scenarios, the greatest risks of introducing MINNS relate to vessels and structures originating from outside UK waters where the chances of exposure to exotic species is greatest. A high risk of introducing MINNS is also associated with structures that have been immersed in seawater, either static or moving at slow speed, for an appreciable amount of time (weeks to months) thus allowing MINNS to become attached prior to arrival or installation. Other risks include the use of supply and support vessels which have inadequate anti-fouling systems as well as the use of subsea inspection and survey equipment which have been improperly cleaned of biofouling.

11.6 Impacts on Benthic and Water Column Communities

11.6.1 Produced Waters

The modelling results demonstrated that the configuration of the discharge exerts a decisive influence on plume behaviour, hence this will influence the design parameters of the produced water outfall, so that appropriate mitigation is built into the design (i.e. discharge temperature, increase of release depth and discharge orientated at a downward angle).

Significant impacts on benthic communities due to discharges of proposed water at the proposed field development are highly unlikely to occur due to the rapid dilution of discharge plumes to below acceptable RBA thresholds which is predicted to occur from 187 meters to 4,404 meters, respectively for scenario S2 (most favourable) and scenario S3 (least favourable) in typical ambient current conditions.

Furthermore, the numerical model studies described above forecast that plumes of produced water discharged at the proposed Cambo field development will remain close to the sea surface (within approximately 19 m even under a worst-case scenario) during their dispersion and therefore will not interact significantly with sea bed communities within and around the site which occur at a depth in excess of 1,070 m Lowest Astronomical Tide (LAT). Equally, significant accumulation of chemicals that may be contained within the produced water discharges within seabed sediments is not anticipated due to the open ocean nature of the proposed field development site, the rapid dilutions predicted to be achieved, the buoyant

nature of the plumes and the water depths involved. Adverse impacts on benthic communities and benthic environmental quality conditions are therefore not expected.

Results of monitoring the ecological effects of oil and gas activity indicate that ecological effects of discharges of produced water are not probable (Research Council of Norway, 2012) while the risk of widespread, long term ecological impact from operational discharges can be considered low (Bakke et al., 2013), although evidence in the available literature is lacking in this regard (Bakke et al., 2013; Blanchard et al., 2013).

Because of the rapid dilution, dispersion and transformation rates of most chemicals in produced water in open-ocean conditions, harmful biological effects of produced water discharges are expected to be minimal and localised (Neff et al., 2002). Furthermore, although several substances potentially harmful to the reproductive success of fish may be present in some produced water discharges, the concentrations that have given rise to adverse effects are normally only found within a few kilometres of the discharge sites and extensive and long term reproductive effects of produced water on fish are not very probable (Research Council of Norway, 2012). Other effects of the components of produced water include alteration in fish enzyme activity, liver oxidative metabolism and cell death, deoxyribonucleic acid (DNA) damage, impaired immunity and gene modification, which can affect overall fish health, while among invertebrate groups, adverse effects on mussel egg development and DNA damage in mussel larvae after hatching have been observed (Research Council of Norway, 2012; Gagnon, 2011; Hamoutene et al., 2011). However, ecological effects that have been detected have typically been associated with a dilution of produced water of 0.1 % or higher, which is found very close to discharge points indicating that effects are usually highly localised (Research Council of Norway, 2012).

Given that the water depth at the proposed Cambo field development is 1,073 to 1,105 m LAT and based on the findings of the produced water modelling (dilution of the plumes that are predicted to be achieved and the buoyant nature of the discharges), any significant interaction with seabed features (e.g. sponge or coral individuals) and accumulation of chemicals within the produced water discharges is highly unlikely. The magnitude of effect from produced water discharges on both benthic and water column communities is judged to be **'Negligible',** as the change to an ecological system or population is unlikely to be noticed or be measured against background variation (see Table 6.1). The species reported from the latest habitat assessment (Fugro, 2025a) and environmental baseline survey (Fugro, 2025d) at the proposed Cambo field development are judged to have a **'Low'** receptor value (a natural and diverse habitat supporting widespread and common species; see Table 6.2). Therefore, the effect significance from produced water discharges on both benthic and water column communities is considered **'Negligible'** and not significant.

Based on the above, any effects on the Priority Marine Feature (PMF) 'offshore subtidal sands and gravels' habitat from the discharge of produced waters from the proposed Cambo field development are also not considered significant.

11.6.2 Impacts on Marine Protected Areas

The Cambo FPSO is located approximately 16 km north of the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA; see Section 5, Environmental Description). The produced water modelling indicated that any effects from the discharge of produced waters from the proposed Cambo field development will be confined within ~4,404 m for the least favourable scenario (scenario S3). Therefore, no impacts are expected on the NCMPA from the discharge of produced waters deriving from the proposed Cambo field development.

11.6.3 Ballast Waters

MINNS threaten local biodiversity if established outside of their natural range (Al-Yamani et al., 2015; Molnar et al., 2008) due to their ability to out-compete native species for space and food resources (Tamelander et al., 2010). Ballast water is recognised as an important vector in the transmission of MINNS between different geographical regions, although MINNS will also be transported within fouling communities on ship hulls or other hard structures.

Documented accounts of species introductions in deep waters around Shetland are limited (e.g. Collins et al., 2015) and any studies are mostly undertaken in coastal waters. The introduction of MINNS could alter water column communities due to the spread of competitively superior and faster growing non-native species. Where established, native species loss may extend beyond the footprint of the development.

Without mitigation in place and assuming the MODU or FPSO will transit from international waters to the West of Shetland, the magnitude of effect from ballast water discharges on water column communities at the proposed Cambo field development is judged to be **'Major'.** The receptor value of the local water column communities is considered as **'Low'**, hence the overall effect significance would be **'Moderate adverse'.**

However, none of the species mentioned in Section 11.5 are found > 100 m of depth. Moreover, the adverse conditions encountered by MINNS (if present) at the proposed Cambo field development region, including strong currents and turbulence, low water temperatures, the open environment and limited artificial substrates for attachment will notably impact negatively on their establishment. Moreover, vessels utilised by the proposed development will comply with the IMO Ballast BWM Convention and any control measures such as ballast water treatment and management plans, or the use of anti-fouling coatings, will reduce the risk of the introduction of MINNS. Cleaning of sampling equipment prior to use offshore will further minimise the risk in this respect. The use of vessels from within the region will also minimise any projected impacts. Based on the above, the risk of the introduction of MINNS is considered to be low and the magnitude of effect from ballast water discharges on benthic and water column communities is judged to be **'Negligible'.** Therefore, the overall effect significance would be **'Negligible'** for a **'Low'** receptor value.

Similarly, the overall effect significance on the PMF 'offshore subtidal sands and gravels' habitat ('**High**' receptor value) from the discharge of ballast waters would also be '**Negligible**' and therefore not significant.

11.7 Best Practice

No significant effects on benthic and water column communities are predicted due to the proposed produced water and marine discharges, and mitigation is thus not considered as being required. However, the produced water modelling indicated that the behaviour of produced water plumes is highly sensitive to discharge configuration (Fugro, 2025g). Moreover, MINNS might be present in the ballast water of the MODU or FPSO (if selection of any of the two is outside the wider Shetland region). Therefore, the following best practice initiatives are provided:

- Reducing the discharge temperature (expected to range between 27 °C and 33 °C; see Section 4.6.7) during discharging, allows for the counteracting of the plume buoyancy for a certain period, thus lengthening the near-field dispersion phase which translates to higher dilution both in the near and far field;
- A downward orientation of the release, as well as increasing the release depth of the discharge will also further increase dilution rates in receiving waters;
- Compliance with the IMO Ballast BWM Convention (install and operate IMO-approved ballast water treatment systems);
- Conduct ballast water exchange in designated offshore areas and maintain a Ballast Water Record Book;
- Ballast water treatment and management plans should be approved and followed;
- Use of anti-fouling coatings;
- Cleaning of sampling equipment prior to use offshore; and
- Use of vessels from within the region.

11.8 In-combination, Cumulative and Transboundary Impacts

Oil and gas activity West of Shetland is relatively low, in comparison with the neighbouring northern North Sea. The BP operated Loyal, Schiehallion and Foinaven fields are located around 41 km, 46 km, and 51 km, respectively, to the south of the Cambo FPSO, and are tied back via the West of Shetland Pipeline (WOSP) to the BP Clair platform, 72 km to the east of the Cambo FPSO (NSTA, 2025d). Given the distance separations between these facilities and the current proposals, no significant cumulative or synergistic impacts are forecasted.

The proposed Cambo wells lie approximately 4 km east of the UK / Faroe Island transboundary line. The dominant movement of produced water discharges from the proposed field development within the ambient current flows is to the northeast and dilution to below the RBA threshold is forecast to be achieved < 4,404 m even under worst-case scenario (S3; see Table 11.2). No significant transboundary issues are therefore expected.

The potential for cumulative and transboundary effects from produced water discharges is considered extremely limited, and therefore considered to be not significant.

11.9 Conclusion

This section has assessed the impact of produced water and marine discharges on the receiving environment at the proposed Cambo field development.

The fate of produced water discharges has been subject to detailed numerical modelling which shows that plumes will be diluted to below the RBA threshold from 187 m and up to 4,404 m from the discharge point under worst-case (low flow water current) scenario. Any environmental effects of produced water discharged at the proposed Cambo field development are expected to be limited given the target of ≤ 15 ppm oil in water (monthly average prior to overboard disposal) set by Ithaca, although ultimately this can only be definitively confirmed once the constituents of the produced water at Cambo are known and are demonstrated to have a PEC:PNEC ratio of ≤ 1. The modelling results will influence the design parameters of the produced water outfall, so that appropriate mitigation is built into the design (i.e. discharge temperature, increase of release depth and discharge orientated at a downward angle).

Only industry standard production chemicals will be used and discharged during operations at the proposed Cambo field development. All chemicals used will be included in the Offshore Chemical Notifications Scheme (OCNS) and the most environmentally friendly options evaluated and, where possible, chemicals that pose little or no risk (PLONOR) to the environment will be used. Additionally, chemical risk assessments will be undertaken as part of the environmental permitting process.

Significant interaction with seabed sediments and communities are highly unlikely due to the rapid dilution rates within receiving waters and the buoyant nature of the plumes so that they will remain near to the sea surface. Other oil and gas facilities are located far beyond the point at which plumes are diluted to below RBA threshold such that potential mixing of respective plumes and potential synergistic effects are highly unlikely to occur. No significant transboundary issues are expected.

The impact of any marine discharge (ballast water release) from the potential use of a MODU or FPSO coming from international waters was assessed as a worst-case scenario on the receiving water column communities during the different stages of the development. As described above, the introduction of MINNS may decrease the diversity and abundance of native species resulting in significant environmental effects. However, considering the remote location of the proposed Cambo field development and with best practices in place, the impact is considered as not significant.

In conclusion, significant effects of the discharge of produced water and ballast water on benthic and water column communities, either alone, or cumulatively with other discharges in the region, are not expected.

12. Underwater Noise

This section assesses the potential impacts arising from the generation of underwater noise. The following issues and concerns regarding underwater noise generation were identified during the Environmental Issues Identification (ENVID) workshop, informal consultations, and in national policies and guidance, as outlined in Section 6 'Identification of Impacts', and will be addressed in this Section.

- The ENVID identified underwater noise generated by a potential Vertical Seismic Profiling (VSP) survey on the optional appraisal well as having a potential significant effect on the marine environment, namely on marine mammals. This concern was also raised by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) during the early consultation, emphasising the need to assess noise emissions from any planned seismic activity;
- The ENVID also highlighted that underwater noise generated by the engines and thrusters of the Mobile Offshore Drilling Unit (MODU)/drillship, the Floating Production, Storage and Offloading (FPSO) vessel, and support vessels could significantly affect the marine environment, particularly marine mammals. This issue was also raised during early consultation by the OPRED;
- Joint Nature Conservation Committee (JNCC) notes that West of Shetland is considered an area of importance for marine mammals and this should be recognised within the Environmental Statement (ES) by considering noise impacts and potential changes in food distribution;
- The Scottish National Marine Plan (NMP) (Section 6.3.1) recognises that noise from drilling, production facilities, and vessels can cause injury and disturbance to noise-sensitive species (GEN13). It also identifies cumulative impacts (GEN21) as a key consideration under its General Policies.

During the drilling operations at the Cambo field development, noise will be generated by the MODU/drillship, its support vessels (i.e. the standby vessel and supply vessels) and by helicopters. Additional (shipping) noise will be generated by the vessels used for the installation of the Cambo FPSO and its associated subsea infrastructure, as well as during the installation of the export pipeline. In addition, a short VSP survey may be undertaken at the optional appraisal well, which will use a small air gun array that will emit high-energy, impulsive sounds over a period of several hours.

During the operational life of the field, the main sources of underwater noise will be from the FPSO and its associated support vessels and the shuttle tankers visiting periodically to offload the crude oil.

Consequently, the underwater noise generated by the potential VSP survey as well as by the MODU/drillship, FPSO, shuttle tankers and support vessels have been identified for further assessment in this section.

This section will also assess the requirement for a wildlife disturbance licence, using the criteria outlined in the latest version of the JNCC draft guidance notes (JNCC, 2010).

12.1 Quantification of Noise

This section discusses the various sources of noise involved in the proposed Cambo field development and presents their typical source levels and frequency content, where available.

12.1.1 Ambient Noise

The ocean's soundscape is highly variable. Ambient or background noise in the ocean consists of a broad range of individual sound sources, both natural and manmade (Hildebrand, 2009).

The dominant source of naturally occurring noise is associated with surface waves generated by the wind. This noise occurs across a range of frequencies from 1 Hz to 100 kHz (NRC, 2003). Other natural sounds in the sea include currents, rain, ice-breaking, echolocation and communication sounds generated by cetaceans and other natural sources such as tectonic activity. Table 12.1 displays some of the different types of sounds found naturally in the marine environment.

Table 12.1: Examples of natural sounds in the marine environment

Sound Source	Dominant Frequency Range	Sound Pressure Density Spectrum Level (dB re 1 $\mu Pa^2/Hz$)	Noise Characteristics
Wind	1 kHz to 25 kHz	65 dB (force 3) 85 to 95 dB (force 12) Dominant frequencies 100 to 200 Hz	Greatest levels at higher wind speeds, noise is continuous on a scale of hours to days
Rain	Broad spectrum	0 dB (no rain) 80 dB (heavy rainstorm)	Flat frequency spectra (white noise)
Earthquakes	5 to 15 Hz	0 dB (no earthquake) 200 to 240 dB (at 10 km from earthquake of ML 4 to 6, broadband)	Short term transitory events on a scale of minutes, noise levels may be high
Baleen whales	16 to a few hundred Hz	128 to 190 dB re µPa @ 1 m	Communication (low frequency moans, grunts, down sweeps)
	2 kHz to 25 kHz	151 dB re µPa @ 1 m	Communication (clicks)
Toothed whales	100 Hz to 20 kHz	Up to 180 dB re µPa @ 1 m	Communication
	6 kHz to 325 kHz	120 to 228 dB re µPa @ 1 m	Echolocation

In addition to naturally occurring sounds, anthropogenic noise is generated by shipping, offshore construction (e.g., pile driving, dredging), oil and gas exploration (e.g., seismic airgun arrays), geophysical surveys (e.g., echosounders, sub-bottom profilers), and naval exercises (e.g., mid-frequency active sonar, explosions). Of these, shipping is the dominant source of sound in the world's oceans (Frankish et al., 2023), covering frequencies from five to a few hundred hertz (NRC, 2003). Sound generated by seismic airguns is also a major contributor to

the low-frequency background noise recorded in certain areas, such as the North Atlantic (Nieukirk et al., 2004; Tyack, 2008).

Anthropogenic noise levels in the oceans have increased significantly over the last few decades (Hatch & Wright, 2007; Andrew et al., 2002) giving marine animals little time to adapt to these changes in an evolutionary sense. This is particularly true for commercial shipping, which had led to an approximate increase of low-frequency ambient noise levels of 3.3 dB per decade during the period between 1950 and 2007 (Frisk, 2012), with similar trends observed for the last two decades (Jalkanen et al., 2022). Shipping noise can affect the behaviour and physiology of sensitive marine fauna such as marine mammals, fish and invertebrates (Basan et al., 2023).

All vessels generate noise as a consequence of their operation and the mechanisms of sound radiation are common to most of them. In particular, propeller cavitation produces the majority of the broadband sound as well as dominant tones at the propeller blade rate (Richardson et al., 1995). The propulsion engines and auxiliary machinery also contribute to the overall sound levels. Even though the mechanisms of noise radiation are shared by most vessels, the spectral characteristics and overall sound levels are highly dependent on the dimensions, speed, general condition, and age of the vessel.

Table 12.2 shows various anthropogenic sources and received levels of sound in the marine environment.

Table 12.2: Sound sources from various maritime activities

Activity	Dominant Frequency Range (kHz)	Average Source Level (dB re 1µPa-m)	Estimated Received Level at Different Ranges (km)			
			0.1 km	1 km	10 km	100 km
High resolution geophysical survey; pingers, side scan, fathometer	10 - 200	<230	190	169	144	69
Low resolution geophysical seismic survey; seismic air gun	0.008 - 0.2	248	210	144	118	102
			208	187	162	87
Production drilling	0.25	163	123	102	77	2
Jack-up drilling rig	0.005 - 1.2	85 - 127	45 - 87	24 - 66	< 41	0
Semi-submersible rig	0.016 - 0.2	167 - 171	127 - 131	106 - 110	81 - 85	6 - 10
Drill ship	0.01 - 10	179 - 191	139 - 151	118 - 130	93 - 105	18 - 30
Large merchant vessel	0.005 - 0.9	160 - 190	120 - 150	99 - 129	74 - 104	< 29
Military vessel	Not known	190 - 203	150 - 163	129 - 142	104 - 117	29 - 42
Super tanker	0.02 - 0.1	187 - 232	147 - 192	126 - 171	101 - 146	26 - 71

Notes
Sources: Adapted from Evans & Nice, 1996 and Richardson et al., 1995.

Figure 12.1 represents ambient noise as a function of frequency. The ambient noise spectrum normally lies between the two thick black lines (Harland et al., 2005; NRC, 2003; Wenz, 1962).

The red line depicts the power spectrum of ambient noise in deep waters with usual vessel traffic and sea state 1. These conditions are representative of the study area and correspond to a broadband sound pressure level (SPL_{rms}) of 101.9 dB re 1µPa calculated over the frequency range of 10 Hz to 100 kHz.

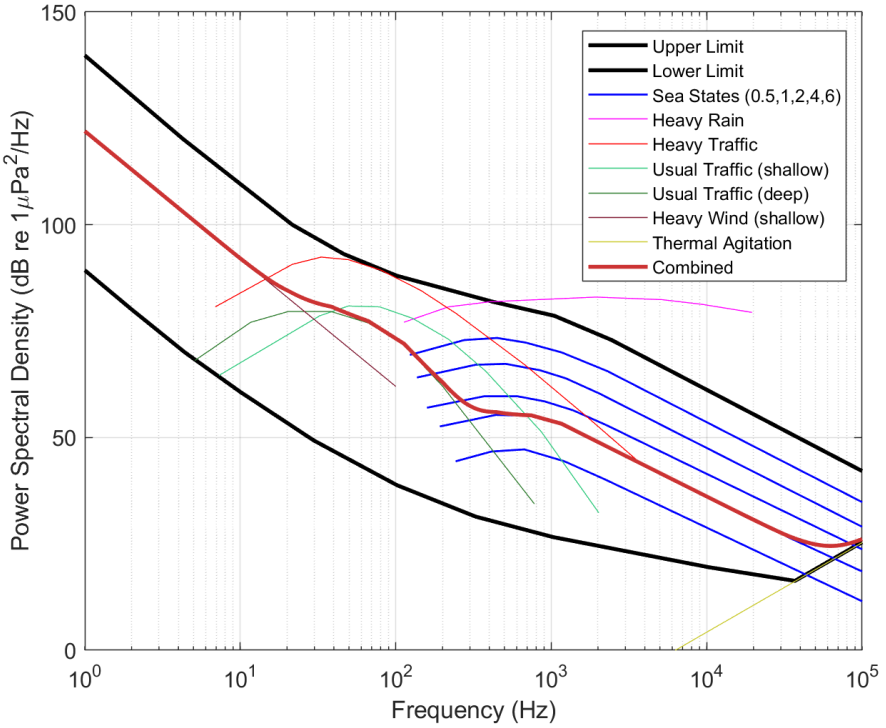


Figure 12.1: Ambient noise power spectral density in the open ocean. Adapted from NRC, 2003.

At the lower frequencies, shipping noise dominates, while at the higher frequencies noise from waves and precipitation is more prevalent. The frequency at which the change occurs is a complex function of local bathymetry, local conditions, shipping levels, and weather conditions.

12.1.2 Acoustic Characteristics of Activities in the Cambo Field

12.1.2.1 Underwater Sound Generated by the VSP Survey

A VSP survey may be undertaken at the optional appraisal well which will be drilled to confirm the optimal location of Drill Centre 3 (DC3). A VSP survey involves a small seismic airgun array being deployed and activated near a borehole (i.e. well), with the recording instrumentation installed inside the well. The combination of the high-resolution seismic imaging with sediment samples obtained through logging provide detailed insights into the geological structure, composition, and geophysical properties in and around the well. VSP survey operations are typically brief, lasting one to two days (IOGP, 2011).

Airgun array parameters used in a recent underwater noise study undertaken for Ithaca's nearby Tornado well in UKCS Block 204/13b (Morgan, 2025) have been used as a proxy to inform the impact assessment for the potential Cambo VSP survey.

The potential VSP survey would use a small airgun array with a total volume of 750 cubic inches (cuin), comprising three identical airguns of 250 cuin each, which will be fired at 20 second

intervals. The estimated sound source exposure level of the array is of 215 dB re 1µPa^{2}m^{2}s. The VSP survey will take approximately 1 to 2 days to complete. The majority of the energy emitted by the source concentrated below 1 kHz.

12.1.2.2 Underwater Sound Generated by the MODU/drillship

Underwater sounds from a MODU or drillship mainly originate from vibrations generated by onboard equipment. These vibrations travel through the structure and into the surrounding water. Some of the acoustic energy radiated into the water is also produced by the drill string and the interaction between the drill bit and the seabed (Austin et al., 2018). These sounds are predominantly concentrated at low frequencies, typically ranging from 10 Hz to 1 kHz, and often include strong tonal components associated with rotation rates from onboard machinery such as generators, engines, pumps, and motors.

Vessels with large surface areas in contact with the water tend to produce higher sound levels (Richardson et al., 1995), making MODUs inherently noisier than fixed platforms (Simmonds et al., 2004). Austin et al., (2018), measured the broadband sound pressure source levels from three MODUs (two hull-based vessels, and a self-propelled drillship) during exploratory drilling, with values ranging from 168.6 dB to 174.9 dB re 1µPa·m. The average spectrum reported for these three MODUs was characterised by a broadband source level of 172.0 dB re 1µPa·m, which has been used as a proxy for the calculations in this impact assessment.

12.1.2.3 Underwater Sound Generated by the FPSO

Erbe et al. (2013) compared the underwater sound levels of six FPSOs operating offshore Australia and found mean source levels between 174 and 181 dB re 1 µPa at 1 m. Dominant frequencies were broadly similar to that of the shuttle tanker described above. It is expected that the underwater sound generated by the Cambo FPSO would be of a similar levels and frequency range.

12.1.2.4 Underwater Sound Generated by Support Shipping

Shipping is a major contributor to noise in the oceans, especially at low frequencies between 5 Hz and 500 Hz (Davis et al., 1990; NRC, 2003; Richardson et al., 1995). Sound levels and frequency characteristics are roughly related to ship size and speed, but there is significant individual variation among vessels of similar classes.

The primary sources of sound from shipping are the propellers, engines and associated propulsion machinery. Other sound sources from ships include auxiliary machinery such as pumps, generators, ventilators, compressors etc (Richardson et al., 1995).

Shipping operations associated with the proposed Cambo field development include regular supply vessel visits and the standby vessel throughout the drilling and subsequent production operations. Typical source levels associated with these types of shipping range between 170 and 180 dB re 1 µPa·m (Richardson et al., 1995). During the production phase, shuttle tankers will periodically visit the FPSO to offload the crude oil and an estimated peak source level of

184.1 dB re 1 µPa·m was used by McPherson et al. (2016) for similar operations, calculated over a frequency range from 10 Hz to 11 kHz and peaking at around 500 Hz.

For acoustic modelling purposes, the source level of 184 dB re 1 µPa·m estimated for the oil tanker will be used as a worse-case scenario for individual vessels participating in the campaign, including the MODU/drillship and FPSO.

12.1.3 Underwater Sound Behaviour

As a sound wave propagates underwater, its energy spreads over an increasingly larger area, leading to a reduction in sound pressure at any given point along its wavefront. In an idealised scenario with a homogenous, infinite body of water and far away from the acoustic source, a spherical wavefront will form. This results in a predictable attenuation of 6 decibels per doubled distance, a phenomenon known as *spherical spreading*, which is mathematically expressed as:

$$PL(r) = 20 \log r \qquad \text{eq. 1}$$

where PL is the propagation loss in dB, r the distance from the source to the receiver in m, and 20 the spherical spreading factor.

However, real-world underwater sound propagation is far more complex. As the sound wave travels between source and receiver, it interacts with the sea surface and seabed, propagating through layers of varying composition. These interactions cause the wave to follow complex paths influenced by the effects of refraction, reflection, and scattering. This phenomenon, known as multipath propagation, is largely governed by local water properties and weather conditions, which introduce considerable temporal and spatial variability.

For example, changes in temperature and salinity with depth can cause sound waves to bend (refract) upwards or downwards, thereby altering the overall propagation loss. Additionally, sound waves experience absorption as they travel through the water column, but this factor only becomes significant over long distances (in the order of km) and at high frequencies (in the order of kHz).

12.1.3.1 Propagation Model

In the area West of Shetland, a large asymmetry between upslope and downslope propagation can be expected over larger distances. Sound propagating downslope may connect with the deep sound channel, allowing it to propagate to long ranges with little attenuation. In contrast, sound propagating upslope can be expected to suffer rapid attenuation due to frequent interactions with the seabed.

Nonetheless, in relatively flat seabed areas with water depths greater than 50 m in depth, and within a few kilometres from the source, attenuation can be reasonably approximated using the spherical spreading law. In such cases, the received level at a range r (in metres) from the source is calculated as:

$$RL(r) = SL - PL(r) \quad \text{eq. 2}$$

with

$$PL(r) = 20 \log r + \alpha r \quad \text{eq. 3}$$

Here, RL is the received level, SL the source level, and PL the propagation loss (ISO, 2017). The absorption factor α is expressed in dB/m and accounts for the volume attenuation in the water column (e.g., 0.063 dB/km at 1 kHz) and additional losses due to seabed interactions. Both RL and SL can be expressed in terms of sound pressure level (SPL) in dB re 1µPa or sound exposure level (SEL) in dB re 1µPa^{2}s. The source level represents the sound level emitted by a point-sized equivalent of the source at 1 m, and similar to the received level, it can be expressed as SPL in dB re 1µPa·m or SEL in 1µPa^{2}m^{2}s.

Numerical simulations using the parabolic equation method (Collins, 1993a; 1993b), combined with a half-space seabed model incorporating typical geoacoustic parameters for clay, silt, and sand (Jensen et al., 2011), indicate that for water depths between 100 and 1,000 m and ranges between 200 m and 25 km, the spherical spreading law provides a good first-order approximation for the propagation loss in the Cambo field (see Figure 12.2).

In this region, the deepest sediments are mainly composed of muddy sands, while the continental shelf features sands with some gravel and mud content. The spherical spreading curve lies between the modelled propagation losses for clay and sand, indicating a reasonable compromise between the higher attenuation associated with deep water sediments and the strong reflectivity of sands in the continental shelf.

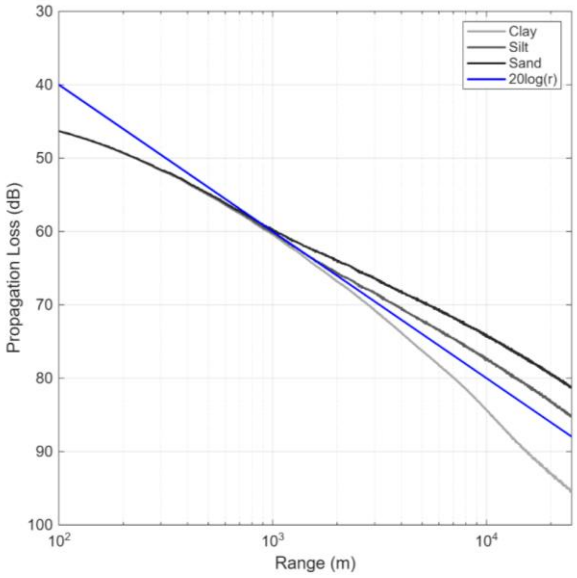


Figure 12.2: Depth and frequency averaged propagation loss in clay (light grey), silt (dark grey), and sand (black) for a 1,000 m water depth. The curves are averaged over the frequency range of 16 Hz to 2 kHz. The blue curve shows the spherical spreading law (eq. 1).

12.1.4 Overview of Sound Level Metrics

The received sound levels RL at a given frequency f and distance r from the source can be conveniently calculated as the difference between the source level SL and the range-dependent propagation losses PL, using the following simple formula:

$$RL(r,f) = SL(f) - PL(r,f)$$

The source level spectrum $SL(f)$ and the propagation loss curves $PL(r,f)$ for the various sound sources under evaluation were presented in sections 12.1.2 and 12.1.3. The propagation losses are considered constant for all frequencies of interest; hence they are assumed to be independent of frequency and can be defined as $PL(r)$ (see eq. 1). The source levels used for the calculations are represented as one-third octave band spectra.

The advantage of working with separate frequencies is that a weighting function can be applied to the sound levels to account for the varying sensitivities that marine mammals have at different frequencies (Southall et al., 2019; NMFS, 2024). For a given auditory weighting function $W(f)$, the 'weighted' (or filtered) broadband received levels can be calculated as

$$RL_w(r) = 10\log\left(\sum_n 10^{\frac{RL_n(r)W(f)}{10}}\right)$$

The 'unweighted' received levels can be calculated with the formula above by assuming a constant hearing sensitivity for all frequencies ($W(f) = 1$).

Sound levels may be expressed as different acoustic metrics. For instance, RL and SL can refer to sound pressure level SPL_{rms} (i.e., SL_{rms}), peak sound pressure level SPL_{0-pk} (i.e., SL_{pk}), and sound exposure level SEL (i.e., SL_E).

The root-mean square (RMS) sound pressure p_{rms} is the square root of the squared instantaneous sound pressure $p(t)$ averaged over a specified interval T and is expressed in pascals (Pa) (ISO, 2017). The sound pressure level SPL_{rms} is the decibel representation of p_{rms}. The sound pressure level SPL_{rms} is used as a measure of the amplitude of continuous acoustic signals and is expressed in decibels referred to one micro pascal (dB re 1µPa).

The peak sound pressure p_{0-pk} is the greatest absolute value of the instantaneous sound pressure $p(t)$ during a specified time interval and is expressed in pascals (Pa) (ISO, 2017). The peak sound pressure level SPL_{0-pk} is the decibel representation of p_{pk} and is expressed in decibels referred to one micro pascal (dB re 1µPa). Due to the broadband nature of SPL_{0-pk}, auditory weighting is not applied to it. The 'unweighted' peak sound pressure level is often referred to as $SPL_{pk,flat}$ (NMFS, 2024). This metric is well suited for characterising large instantaneous amplitudes from impulsive signals. For seismic airgun pulses, the range-dependent peak sound pressure level $SPL_{0-pk}(r)$ was obtained from the (single-strike) 'unweighted' sound exposure level $SEL(r)$ using the method described by Galindo-Romero et al. (2015).

The sound exposure E_p is the integral over a specified time interval T of the squared instantaneous sound pressure $p(t)$ and is expressed in pascal-squared second (Pa^2s) (ISO, 2017). The sound exposure level SEL is the decibel representation of the sound exposure and is expressed in decibels referred to one micro pascal-squared second (dB re $1\mu Pa^2s$). The single-strike sound exposure level SEL_{ss} is a term commonly used to emphasise that the sound exposure was calculated over the duration of a single sound event. This terminology is used to distinguish it from the cumulative sound exposure level SEL_T, which indicates that the energy is accumulated over a long period T or a number of individual sound events. There is no mathematical difference between the two. Noise impact guidelines for marine mammals and fish recommend a 24-hour integration period and auditory weighting for the cumulative sound exposure level, denoted by $SEL_{24h,w}$ (NMFS, 2024; Popper et al., 2014). The cumulative sound exposure level is better suited than SPL_{rms} for the assessment of noise impacts, due to the correlation of the accumulated acoustic energy with hearing fatigue.

The peak sound pressure level SPL_{0-pk} and the 24-hour 'weighted' cumulative sound exposure level $SEL_{24h,w}$ are the primary metrics used in noise impact assessments for marine mammals according to the latest guidelines (Southall et al., 2019; NMFS, 2024). For fish, the 'unweighted' cumulative sound exposure SEL_T is used instead of $SEL_{24h,w}$, as a standardised auditory weighting function does not currently exist due to the complexity and variability of fish hearing. Currently, SPL_{rms} is only used as an unweighted metric for the noise impact assessment of fish from continuous sources such as vessels or sonar (Popper et al., 2014).

The behaviour of the marine animal plays a key role in the accumulation of the sound exposure. For instance, if the animal remains static at a distance from the source, the overall cumulative sound exposure will be higher compared to that of a fleeing animal. If instead the animal swims

away from the source at a speed v and the source emits pulses every Δt seconds, the 'weighted' cumulative exposure will be given by

$$SEL_{24h,w}(r) = 10\log\left(\sum_i 10^{\frac{SL_{E,W}-PL_n(r+iv\Delta t)}{10}}\right)$$

where $i = 0,1,2,\ldots M$ is the index of each sound event in the sequence (0 is the first and M the last), $v\Delta t$ is the distance covered by the animal between each pulse, and r is the departing distance. Since propagation losses increase with range, this second scenario will result in lower cumulative sound exposure. This equation was used to calculate the 'weighted' cumulative sound exposure level for each marine mammal functional hearing group (FHG) exposed to seismic pulses from the VSP survey. For a fleeing response scenario, the marine mammal is assumed to swim away from the source at a speed of 1.5 m/s, until it reaches a 'safe distance', where it will remain. This 'safe distance' is assumed to coincide with the sound level at which the animal shows no further behavioural responses. Estimations of impact ranges for fish and marine mammals exposed to vessel noise considered no fleeing response ($v = 0$ m/s).

12.2 Impacts from Underwater Noise

Sound is particularly efficient at propagating through water, and many marine animals have evolved to use hearing as their primary sense. Cetaceans, in particular, are heavily dependent on sound for foraging, communication, reproduction, navigation, and predator avoidance (Hildebrand, 2009; Weilgart, 2007).

The ocean is a naturally noisy environment, and cetaceans have evolved ears that function well within this context. Anatomical and behavioural studies suggest that whales and dolphins may be more resistant than many land mammals to transitory physiological effects such as temporary threshold shifts (TTS). However, these data also show that they are subject to disease and aging processes and are therefore not immune to hearing loss. Increasing ambient noise via human activities is a potential candidate for exacerbating or accelerating such losses (Ketten, 2004).

The introduction of additional noise into the marine environment could potentially interfere with the animals' ability to interact with other individuals and the environment. This increase in noise could therefore cause short term behavioural changes and, in more extreme cases, cause auditory damage. In addition, underwater sound may also cause behavioural changes in other animals such as fish and diving seabirds.

This section presents the potential impacts from underwater sound produced during the drilling, the VSP survey and during the production phase of the Cambo field development. The assessment focuses on marine mammals and fish which are the receptors believed to be most at risk from noise impacts.

12.2.1 Impacts of Noise on Marine Mammals

12.2.1.1 Marine Mammals and Noise

Marine mammals use sound in various important contexts, such as in social interactions, foraging, and response to predators (Frankish et al., 2023; Southall et al., 2007). Hearing is the primary sensory system for marine mammals, which is clearly shown by the development level of their ear and neural auditory centre (Ketten, 2004). As the sea has never been a silent place, the ears of marine mammals, and those of whales and dolphins in particular, have evolved to function well within this context of ambient noise. However, little information exists to describe how marine mammals respond physically and behaviourally to intense sounds and to long term increases in ambient noise levels (NRC, 2003).

The hearing sensitivity of marine mammals varies significantly between species. In order to assess the impacts of sound, these animals can be classified into FHGs (NMFS, 2016; 2018; 2024; Southall et al., 2007; 2019). This classification takes into account that not all marine mammal species have identical hearing, or susceptibility to temporary and permanent noise-induced hearing loss. Outside their generalised hearing range, animals may be able to detect loud sounds, but the risk of auditory impacts is considered highly unlikely or very low.

Table 12.3 applies the most up to date classification by Southall et al. (2019) to the species that may be present in the wider area around the proposed Cambo field development.

Table 12.3: Functional hearing groups for marine mammals potentially present at the Cambo field development

Functional Hearing Group	Nominal Hearing Range**	Species Potentially Present at the Cambo Field Development
Low-frequency cetaceans (LF)	7 Hz to 36 kHz	**Fin whale***; sei whale; minke whale; *blue whale** and *humpback whale*;
High-frequency cetaceans (HF)	150 Hz to 160 kHz	**Atlantic white-sided dolphin**; **killer whale**; **Long finned pilot whale; sperm whale*;** common dolphin; Risso's dolphin; White-beaked dolphin; Northern bottlenose whale
Very High-frequency cetaceans (VHF)	200 Hz to 165 kHz	Harbour porpoise
Pinnipeds in water (PW)	40 Hz to 90 kHz	*Hooded seals*

Notes
Species listed in '**bold**' occur regularly; whereas species listed in 'normal' text are recorded in lesser extent. Species listed in '*italics*' have only been observed occasionally.
* Have been recorded in the area as migratory species.
** Generalised hearing range based on a ~65 dB threshold applied to the composite audiogram of each functional hearing group. Based on analysis and data from NMFS (2018) and Southall et al. (2007; 2021).

Sources:
DECC, 2016; NMFS, 2024; Pollock et al., 2000; Reid et al., 2003.

All odontocetes (also known as 'toothed whales') listed in Table 12.3 are classed as 'very high -frequency cetaceans' or 'high-frequency cetaceans'. These classifications are based on the fact that odontocetes have highly advanced echolocation systems that use intermediate to

very high frequencies. They also produce social sounds in a lower-frequency band, including generally low to intermediate frequencies (1 kHz to tens of kHz). Consequently, their functional hearing is expected to cover this whole range; however, their hearing sensitivity typically peaks at, or near, the frequency where echolocation signals are strongest (Southall et al., 2019), hence the split between 'high' and 'very high' frequency cetaceans.

All mysticetes (i.e. the large baleen whales) are all categorised as 'low-frequency cetaceans'. No direct measurements of hearing exist for these animals and theories regarding their sensory capabilities are consequently speculative. In these species, hearing sensitivity has been estimated from behavioural responses (or lack thereof) to sounds at various frequencies, common vocalisation frequencies, ambient noise levels at the frequencies they use most, body size, and cochlear morphology. At present, the lower and upper frequencies for functional hearing in mysticetes, collectively, are estimated to be 7 Hz and 36 kHz (NMFS, 2024).

Pinnipeds (seals, sea lions, and walruses) also produce a variety of sounds, generally over a lower and more restricted bandwidth (from 100 Hz to several tens of kHz). These sounds are primarily used in critical social and reproductive interactions (Southall et al., 2007). Most pinniped species have peak sensitivities between 1 and 20 kHz (NRC, 2003).

Research indicates that marine mammals can react differently to the introduction of additional noise into the marine environment. Reactions may vary depending on sound source level, propagation conditions and ambient noise, in addition to species, age, sex, habitat, individual variation, and previous habituation to noise (Richardson et al., 1995). It should also be noted that marine mammals react differently to stationary noise, compared to sudden bursts of noise and noises that appear to be coming towards them.

Studies suggest that most cetaceans will alter their course or display avoidance reactions to a noise that appears to be moving directly towards them. Stationary noises, such as drilling noises, seem to have a lesser effect in disturbing migration patterns and animal feeding, although data and observations on this matter are limited (Davis et al., 1990).

12.2.1.2 Noise Impact Criteria for Marine Mammals

Over the past 20 years or so, a concerted effort has been made to create a set of injury criteria for individual marine mammals exposed to discrete noise events, started by Southall et al. (2007). The most up to date marine mammal impact criteria are included in the latest technical guidance from NMFS (2024).

These impact criteria aim to set acoustic thresholds, at which individual marine mammals are predicted to experience changes in their hearing sensitivity (either temporary or permanent) for acute, incidental exposure to underwater anthropogenic sound sources. These *received level* thresholds are referred as 'Temporary Threshold Shift' (TTS), 'Auditory Injury' (AUD INJ) and 'Permanent Threshold Shift' (PTS). The guidance makes a clear distinction between impulsive and non-impulsive sound sources, based on their physical characteristics at the source, with impulsive sound having physical characteristics making them more injurious (NMFS, 2024).

The thresholds are defined for various functional hearing groups, source types, and impact levels, for two different acoustic metrics: single-pulse unweighted ('flat') peak sound pressure level ($SPL_{0\text{-}pk}$) and 24-h weighted cumulative sound exposure level ($SEL_{24h,w}$). Although in the evaluation of impact from non-impulsive sounds $SEL_{24h,w}$ is the main acoustic metric, the *dual-criteria* should be considered if the non-impulsive sound has the potential of exceeding the peak sound pressure level criteria associated with impulsive sounds (NMFS, 2024). One should use the metric that results in the largest impact range. Table 12.4 presents the acoustic thresholds for 'impulsive' and 'non-impulsive' sound sources.

Table 12.4: PTS[1] and TTS onset thresholds for impulsive and non-impulsive sounds (NOAA, 2024).

Group	Impulsive Source				Non-Impulsive Source	
	TTS ($SPL_{0\text{-}pk}$)	TTS ($SEL_{24h,w}$)	PTS ($SPL_{0\text{-}pk}$)	PTS ($SEL_{24h,w}$)	TTS ($SEL_{24h,w}$)	PTS ($SEL_{24h,w}$)
LF	216	168	222	183	177	197
HF	224	178	230	193	181	201
VHF	196	144	202	159	161	181
PW	217	168	223	183	175	195

Notes
LF = Low frequency cetaceans; HF = High frequency cetaceans; VHF = Very high frequency cetaceans; PW = phocid pinnipeds in water (PW).

12.2.1.3 PTS and TTS Impact Ranges for Marine Mammals

The proposed Cambo field development will contribute to the existing ambient sound in the development area. The underwater sound produced by the FPSO itself, support vessels, the shuttle tankers and the MODU/drillship are 'non-impulsive' sounds at relatively low frequencies. In contrast, the seismic airgun array used in the VSP survey will produce intermittent, 'impulsive' sound pulses which are considerably more intense than the continuous noise emitted by most industrial noises in the ocean, including those from the FPSO, MODU/drillship or their support vessels.

Table 12.5 shows the PTS and TTS impact ranges (or 'isopleths') for all marine mammal functional hearing groups for the main identified noise producing activities. For impulsive sources such as seismic airgun pulses, the impact range is taken as the worst of the dual criteria ($SPL_{0-pk}, SEL_{24h,w}$) for the selected impact level (PTS, TTS) and is highlighted in green. Impact ranges lower than the model's resolution (< 2.5 m) are considered *null impacts* and are greyed out.

The MODU/drillship and vessels involved in the drilling and production stages do not incur PTS or TTS for marine mammals. Therefore, the risk of physiological impact from the MODU/drillship, FPSO, Reel Lay Vessel (RLV), Anchor Handling Vessel (AHV), and support vessels on marine mammals is considered minimal.

[1] In NOAA's technical guidance (2024), the term "permanent threshold shift" (PTS) has been replaced by "auditory injury" (AUD INJ). However, the term PTS is retained here for consistency with the rest of the text.

The underwater sounds generated during the VSP survey produce intermittent, impulsive sounds which are considerably more intense than the continuous signals emitted by most industrial acoustic sources in the ocean. The underwater sound pulses from the 750 cuin seismic airgun array can result in various degrees of physiological impact, in particular for low frequency cetaceans which may experience PTS at distances closer than 9 m and TTS at ranges of up to 92 m. Very high frequency cetaceans can be affected by PTS up to distances of 35 m from the source, with an impact range of 61 m for TTS. Phocid pinnipeds must get even closer to the source to experience physiological impacts, with a 5 m radius isopleth for PTS and 8 m for TTS. High frequency cetaceans are not expected to be affected by physiological effects from noise, with both PTS and TTS threshold being less than 2.5 m of the source. Additionally, the estimated PTS and TTS impact ranges resulting from cumulative exposure to vessel noise are all under 10 m, indicating that this type of continuous noise is likely to have minimal effects on the marine mammals in the area.

It should be noted that in the calculations, the acoustic sources are modelled as theoretical point source. A real source, however, is comprised of multiple emitters which produce a complex interference sound pattern in its vicinity, known as *near field*. Further away from the source, the near field transitions to *far field*, where the behaviour of the sound waves become predictable and the point source approximation holds. The larger the source and the higher the frequency, the further away is the far field region (Foote, 2014). When interpreting the impact distances below, it should be noted that some will fall within the near field leading to over-estimations in the immediate vicinity of the sources. The far field of the airgun array is expected to occur at several meters from the source, whereas it can be of the order of 1 km for the MODU/drillship, FPSO and vessels.

Table 12.5: PTS and TTS noise impact ranges for marine mammals

Source	Impact Level	Acoustic Metric	Impact Range per Functional Hearing Group (m)			
			LF	HF	VHF	PW
VSP Survey	PTS	SPL_{0-pk}	5	< 2.5	35	5
		$SEL_{24h,w}$	9	< 2.5	< 2.5	< 2.5
	TTS	SPL_{0-pk}	9	4	61	8
		$SEL_{24h,w}$	92	< 2.5	< 2.5	5
Vessels (MODU/drillship, FPSO, shuttle tanker, support)	PTS	$SEL_{24h,w}$	3.5	< 2.5	4.5	< 2.5
	TTS	$SEL_{24h,w}$	6.5	< 2.5	8.5	3.5

Notes
LF = Low frequency cetaceans; HF = High frequency cetaceans; VHF = Very high frequency cetaceans; PW = phocid pinnipeds in water (PW); SPL_{0-pk} = peak sound pressure level in dB re 1 µPa; $SEL_{24h,w}$ = 24-hour weighted cumulative sound exposure level in dB re 1 µPa^{2}s.
Cells highlighted in green indicate the dual metric impact range (i.e., the highest of the two metrics).
Cells greyed out indicate a null impact (i.e., no PTS or TTS for the specific source and FHG).

Based on the impact ranges outlined above, all of which are under 100 m, and assuming the VSP survey will only commence when no marine mammals present within 500 m from the airgun array before the seismic activity begins, in line with the JNCC guidelines for minimising

injury and disturbance from seismic surveys (JNCC, 2017), it is considered unlikely that the survey would cause any physical injury to marine mammals in the area.

12.2.1.4 Behavioural Responses of Cetaceans to Seismic Airguns

Although it is unlikely that the VSP survey will cause injury, it may very well evoke some behavioural responses from any cetaceans in the vicinity of such operations.

Baleen whales have hearing sensitivity ranges between 10 Hz and 10 kHz, with greatest sensitivities usually below 1 kHz (Evans, 1998; Southall et al., 2019). This hearing range overlaps the low frequency sounds produced by the planned VSP survey operations, which may mask long distance communication between whales and prevent the detection of other faint sounds (Evans & Nice, 1996). For example, a seismic survey using a low-medium power sparker caused the blue whales to increase the number of vocalisations in what the authors believe was an attempt to compensate for the introduction of low frequency noise (Di Iorio & Clark, 2009).

Instances of marine mammals vacating the area to avoid seismic noise have been well documented. Castellote et al. (2012) reported significant displacement of fin whales during a prolonged seismic survey. Similarly, a study from Stone and Tasker (2006), which observed marine mammal presence and behaviour during 201 seismic surveys in the UK, found evidence of localised spatial avoidance among slow-moving mysticetes. These animals tended to orient away from the survey vessels and increased their distance, although they did not leave the area entirely. In contrast, small odontocetes exhibited strong lateral avoidance, rapidly moving out of the immediate vicinity, often beyond the limits of visual observation. Notably, behavioural responses were stronger when larger seismic arrays were used.

Most studies on low-frequency cetaceans report behavioural responses to 'pulsed sound', such as that seismic surveys, at received sound levels around 140 to 160 dB re 1 µPa, and sometimes even higher (Richardson et al., 1995; Southall et al., 2019). These responses typically consist of subtle effects on surfacing and respiration patterns. Responses can differ based on species, sex, age, and context. Sound levels of 140 dB to 180 dB will generally evoke behavioural avoidance reactions (Richardson et al., 1995; Weilgart et al., 2013). Furthermore, the acoustic threshold for the onset of behavioural disturbance (or 'Level B harassment') for marine mammals as set out in the US National Marine Fisheries Service guidance 160 dB 1 µPa for impulsive noise (NMFS, 2005). Using the unattenuated spherical spreading law (eq. 1) and considering a SPL_{rms} of 215 dB re 1µPa for the 750 cuin seismic airgun array, a received sound level of 160 dB 1 µPa is expected to occur at 560 m from the source.

Given the intermittent nature and short overall duration of the VSP survey operations (1 to 2 days), and the anticipated impact on cetaceans is limited to potential avoidance responses by individual animals of up to a range of 560 m, comparable to the pre-search zone recommended by the JNCC guidelines for seismic surveys (JNCC, 2017), the overall impact of the VSP survey activities on cetaceans is considered not significant. The assessment assumes that appropriate mitigation measures, including monitoring for the presence of marine mammals in the area, are implemented in accordance with the JNCC guidelines.

In conclusion, by applying the proposed mitigation measures outlined in the JNCC Guidelines minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) and bearing in mind the short overall duration of the VSP survey operations, the magnitude of effect can be classed as '**Minor**'. As internationally protected species, all cetaceans qualify as having a '**Very High'** receptor value. Hence, the environmental effect of the proposed VSP survey operations at the Cambo field development will result in a '**Minor adverse**' effect and consequently may be considered as not significant.

12.2.1.5 Behavioural Responses of Pinnipeds to Seismic Airguns

Very few studies have been conducted on the effects of impulsive noise on pinnipeds, even though they are known to have good underwater hearing, and their feeding grounds often overlap with areas subject to manmade high intensity underwater noise activities. Kvadsheim et al. (2010) did a small study on the behavioural and physiological responses of 1 to 7 kHz sonar signals on hooded seals. The study showed active avoidance behaviour in hooded seals at received sound pressure levels exceeding 160 to 170 dB_{RMS} (re 1 µPa). The behavioural response involved reduced diving and initial swimming away from the sonar source, followed by rapid behavioural adaptation, resulting in passive floating at the surface.

A review of the effects of seismic survey impacts on marine mammals by Gordon et al. (2003) quotes a study by Thompson et al. (1998) on the behavioural and physiological responses of grey and common seals to small airguns. The study indicated that reactions observed in common seals included initial fright responses as the air guns were switched on, generally followed by strong avoidance behaviour, demonstrated by swimming rapidly away from the sound source. However, the study also reported that one seal showed no detectable response and approached to within 300 m of the airgun (source levels of the airgun were 215 to 224 dB re 1 µPa at 1 m peak-to-peak). The seals ceased feeding during this time. The behaviour of the common seals seemed to return to normal soon after the air guns were switched off.

Bearing in mind that the VSP survey will be intermittent and occur over a short period of time (1 to 2 days), any affected seals are expected to avoid the area during the VSP operations, but are expected to return to the area quickly after seismic operations have ceased. Consequently, the overall impacts from the VSP survey operations are not believed to cause any long-term effects on pinnipeds and therefore are deemed insignificant.

Similar to the justification presented Section 12.2.1.4, the magnitude of effect is judged to be '**Minor**'. Hooded seals are listed under Appendix III of the Bern Convention and thus qualify as internationally protected species, giving them a '**Very High**' receptor value. Hence, the environmental effect of the proposed VSP survey operations at the Cambo field development will result in a '**Minor adverse**' effect and consequently is not considered as not significant.

12.2.1.6 Behavioural Responses of Cetaceans to FPSO, MODU/drillship, Shuttle Tanker, and Support Vessels

Southall et al. (2007) showed that the reactions of mid frequency cetaceans (i.e. dolphin species and toothed whales) to non-pulsed sounds were much more varied than for impulsive sounds and did not lead to a clear conclusion about received sound levels coincident with various behavioural responses. However, upon reviewing those studies based on vessel noise and presence, and playbacks of drilling sounds, for example, it seems that the general behavioural response threshold may range between a few hundred metres to a few kilometres from the sound source. It seems therefore reasonable to assume that similar response distances can be expected around the FPSO, MODU/drillship, shuttle tanker and other support vessels associated with the proposed field development.

The review of Southall et al. (2007) indicates that low frequency cetaceans (i.e., large baleen whales) typically start to show avoidance and other behavioural responses to this type of 'non-pulsed' sounds at levels between 120 to 160 dB re 1µPa. Applying the propagation loss from eq. 1 and using the sound source pressure level of 184 dB re 1 µPa for vessel activity, along with the most conservative behavioural disturbance threshold of 120 dB re 1µPa, the estimated onset range for the behavioural responses under this worst-case scenario is 1,585 m. It is important to note that the 184 dB re 1 µPa represent the highest expected source level from any individual vessel activity, including those from the MODU/drillship and FPSO (see Section 12.1).

Given the limited scale of the effects described above, and the relatively short range over which these effects occur (1,585 m), the underwater noise produced by the FPSO, MODU/drillship, shuttle tanker, and other support vessels at Cambo are not expected to have any significant impact on cetaceans.

The magnitude of effect is judged to be '**Minor**'. Cetaceans, as discussed previously, are a considered to be a receptor of '**Very High**' value. Hence, the underwater noise generated by the FPSO, MODU/drillship, shuttle tanker and support vessels at the Cambo field development is considered to result in a '**Minor adverse**' effect and consequently is not considered as not significant.

12.2.1.7 Behavioural Responses of Pinnipeds to FPSO, MODU/drillship, Shuttle Tanker, and Support Vessels

The majority of sounds produced by the FPSO, MODU/drillship, shuttle tanker and other support vessels are continuous and of low frequency. Continuous sound levels between 90 and 140 dB re 1µPa do not appear to induce strong behavioural responses in pinnipeds (Southall et al., 2007). Using the propagation loss from eq. 1, the sound source pressure level of 184 dB re 1 µPa for vessel activity, and a conservative sound pressure level of 140 dB re 1µPa for behavioural disturbance on pinnipeds, the estimated onset range for pinniped behavioural response is 158 m.

Due to the low number of pinnipeds likely to be present in the area around the Cambo field development, together with the limited spatial extent of the anticipated impact on seals, the effects of noise generated by the FPSO, MODU/drillship, shuttle tanker and other support vessels are therefore considered minimal.

The magnitude of effect is therefore assessed as being '**Negligible**' due to the limited distance at which behavioural disturbance in pinnipeds may occur. As discussed previously, pinnipeds, specifically Hooded seals, are a deemed to be a receptor of '**Very High**' value. Hence, the underwater noise generated by the FPSO, MODU/drillship, shuttle tanker and support vessels at the Cambo field development is considered to result in a '**Minor adverse**' effect and consequently is not considered as not significant.

12.2.2 Impacts on Fish

12.2.2.1 Fish and Noise

The inner ear of fish, including elasmobranchs (sharks, skates and rays), is very similar to that of terrestrial vertebrates, and hearing is understood to be present in virtually all fish (NRC, 2003). Most species of fish are able to detect sounds from below 50 Hz (some as low as 10 Hz or 15 Hz) to upward of 1,000 Hz. Moreover, a number of fish species have auditory adaptations that enhance sound detection and enable them to detect sounds of 1 kHz and above, giving them better sensitivity than non-specialist species at lower frequencies (NRC, 2003; Popper, 2003). Many species of fish use sound to find prey, to avoid predators, and for social interactions. In addition, the sensory systems used by fish to detect sounds are very similar to those of marine (and terrestrial) mammals and, as a consequence, sounds that damage or affect marine mammals could in other ways have similar consequences for fish (Popper, 2003). Some fish species, such as herring, have swim bladders which may be susceptible to damage by high underwater noise levels, making these species comparatively more sensitive.

12.2.2.2 Noise Impact Criteria for Fish

Popper et al. (2014) developed a sound exposure guideline for fish and sea turtles, similar to what Southall et al. (2007) prepared for marine mammals. They reviewed a number of studies and subsequently suggested various noise thresholds related to potential acoustic impacts. The thresholds were provided for specific sound sources and broad groups of animals, defined by the way they detect sound. The functional hearing groups of fish are summarised in Table 12.6.

Table 12.6: Fish functional hearing groups (Popper et al., 2014)

Group	Acronym	Category	Description
1	FNSB	Fish with no swim bladder	Sensitive only to particle motion rather than sound pressure. Relatively unsusceptible to barotrauma[2]. Sensitive to sound within a narrow band of frequencies. This class includes flatfish, sharks, and rays.
2	FSBV	Fish with swim bladder in which hearing does not involve the swim bladder	Sensitive only to particle motion. Susceptible to barotrauma. Sensitive to sound within a narrow band of frequencies. Although fish in this class have a swim bladder and thus the organ is able to respond to sound pressure, the swim bladder is not connected to the inner ear. This class includes salmonoids (*Salmonidae*) and some tunas and mackerels (*Scombridae*), but many other species are likely to fit into this category.
3	FSBP	Fish with swim bladder in which hearing involves the swim bladder	Sensitive to both particle motion and sound pressure. The swim bladder is close to or intimately connected to the inner ear. Susceptible to barotrauma. Species in this class are sensitive to sounds over a wide frequency range (up to several kHz) and have a higher sensitivity than fish in the preceding groups. This class includes squirrelfishes (*Holocentridae*), drums and croakers (*Sciaenidae*), herrings (*Clupeidae*) and the large group of otophysan fishes.
4	FEL	Fish eggs and larvae	Studies show that their hearing abilities are similar to those of the adult of the species. Swim bladders may develop during the larval stage hence those species are particularly sensitive to barotrauma. There is very little data on the effects of sound or vibration on fish eggs.

The acoustic thresholds provided by Popper et al. (2014) cover the categories of impact summarised in Table 12.7 below.

Table 12.7 Categories of noise impact on fish (Popper et al., 2014)

Effect	Acronym	Description
Potential Mortal Injury	PMI	Severe physical injury that leads to death either immediately or shortly afterwards.
Recoverable Injury	RI	Physical injury not likely to result in death, which may include hair-cell damage, and minor internal or external haematoma.
Temporary Threshold Shift	TTS	Temporary hearing damage that is recoverable over time.
Masking	-	The external sound is sufficiently loud to hide or inhibit the perception of key acoustics cues, such as vocalisations from conspecifics or hunting noises from predators.
Behavioural Effects	-	Discernible changes in the animal's behaviour triggered by sound exposure, such as large-scale and long-lasting movements away from feeding and breeding sites, or cessation of breeding or spawning activity.

[2] Barotrauma is tissue injury caused by rapid pressure changes (e.g., from intense sound or a rapid change in diving depth) which create a significant pressure gradient between the gas-filled organ and the surrounding tissues. This pressure difference can lead to the rapid expansion and contraction of the gas chamber, or cause gases in the bloodstream to come out of solution. Low levels of damage involve stretching of the tissue in tension or shear, whereas higher levels can result in tissue rupture, which can lead to fatalities.

A dual-impact criterion of peak sound pressure level (SPL_{0-pk}) and cumulative sound exposure level (L_E) is used for impulsive sources with thresholds related to permanent physiological impact, such as Potential Mortal Injury (PMI) and Recoverable Injury (RI). For TTS, behavioural disturbance, and masking, the thresholds are defined exclusively using the cumulative sound exposure level metric. For non-impulsive, continuous acoustic sources, the RMS sound pressure level (SPL_{rms}) replaces SEL.

The acoustic thresholds are defined for three types of impulsive sources (explosions, impact pile driving, and seismic airguns) and three types of continuous sources (low frequency naval sonar, mid-frequency naval sonar, and shipping). When insufficient data is available to support numerical values, the relative likelihood of a given effect occurring is provided at three distances from the source: 'near' (N) within tens of meters, 'intermediate' (I) within hundreds of meters, and 'far' (F) within thousands of metres.

It is important to note that the actual likelihood of effects depends on the received level and therefore on the type of source. The impact criteria for PMI, RI, and TTS for fish, larvae and eggs for sounds from impact pile driving and shipping noise are summarised in Table 12.8 and Table 12.9. The criteria for shipping noise can also be applied to other broadband continuous sounds, such as drilling.

Table 12.8: Fish impact criteria for impact pile driving sounds (Popper et al., 2014)

Category	Mortality and Potential Mortal Injury (PMI)	Recoverable Injury (RI)	Temporary Threshold Shift (TTS)
Fish without swim bladder, particle motion detection (FNSB)	$SEL > 219\ dB$ re $1\mu Pa^2s$ $SPL_{pk} > 213\ dB$ re $1\mu Pa$	$SEL > 216\ dB$ re $1\mu Pa^2s$ $SPL_{pk} > 213\ dB$ re $1\mu Pa$	$SPL \gg 186\ dB$ re $1\mu Pa^2s$
Fish with swim bladder, particle motion detection (FSBV)	$SEL > 210\ dB$ re $1\mu Pa^2s$ $SPL_{pk} > 207\ dB$ re $1\mu Pa$	$SEL > 203\ dB$ re $1\mu Pa^2s$ $SPL_{pk} > 207\ dB$ re $1\mu Pa$	$SEL > 186\ dB$ re $1\mu Pa^2s$
Fish with swim bladder, primary pressure detection (FSBP)	$SEL > 207\ dB$ re $1\mu Pa^2s$ $SPL_{pk} > 207\ dB$ re $1\mu Pa$	$SEL > 203\ dB$ re $1\mu Pa^2s$ $SPL_{pk} > 207\ dB$ re $1\mu Pa$	$SEL = 186\ dB$ re $1\mu Pa^2s$
Eggs and larvae	$SEL > 210\ dB$ re $1\mu Pa^2s$ $SPL_{pk} > 207\ dB$ re $1\mu Pa$	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Table 12.9: Fish impact criteria for shipping and continuous sounds (Popper et al., 2014)

Category	Mortality and Potential Mortal Injury (PMI)	Recoverable Injury (RI)	Temporary Threshold Shift (TTS)
Fish without swim bladder, particle motion detection (FNSB)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low
Fish with swim bladder, particle motion detection (FSBV)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low
Fish with swim bladder, primary pressure detection (FSBP)	(N) Low (I) Low (F) Low	$SPL_{rms} = 170\ dB$ re 1µPa (48 h exposure)	$SPL_{rms} = 158\ dB$ re 1µPa (12 h exposure)
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low

12.2.2.3 Injury and Auditory Thresholds for Fish

Table 12.5 summarises the impact ranges for fish from the VSP survey, and vessel-related activities including the MODU/drillship, FPSO, AHV, RLV, CSV, and other support vessels. Seismic airgun activity from VSP presents the highest risk to physical and physiological impact on fish from all the evaluated sources. The VSP survey will induce potential mortal injury within 22 m of the array for pressure-sensitive species (FSBP, FSBV), as well as eggs and larvae (FEL). The PMI is related to the SPL_{pk} metric and is therefore attributed to the sudden increase in sound pressure. The PMI impact range for fish with no swim bladder (FNSB) is 12 m, approximately half the value for pressure-sensitive groups. TTS onset from cumulative exposure will occur for all species of adult and juvenile fish within 35 m from the sound source.

The continuous sources present a comparatively lower risk to fish. Noise from the MODU/drillship, FPSO, and support vessel operations can result in TTS for the FSBP group only within 20 m from the sound source, with 'minor' risk for RI (5 m). For the other categories of fish, there is only a 'moderate' risk for TTS within tens of metres from the source, with 'low' risk for longer distances. The risk of mortality (PMI) is considered 'low' at any distance from a continuous source.

Table 12.10: PMI, RI, and TTS noise impact ranges (in meters) for fish as a result of exposure to sounds from the VSP survey, drilling, and vessel activity in the Cambo field.

Source	Impact Level	Acoustic Metric	FNSB	FSBV	FSBP	FEL
VSP Survey	PMI	SPL_{0-pk}	12	22	22	22
		SEL_{24h}	<2.5	<2.5	<2.5	<2.5
	RI	SPL_{0-pk}	12	22	22	N/A
		SEL_{24h}	<2.5	4	4	N/A
	TTS	SEL_{24h}	35	35	35	N/A
Vessels (MODU / drillship, FPSO, shuttle tanker, support)	RI	SPL_{rms}	N/A	N/A	5	N/A
	TTS	SPL_{rms}	N/A	N/A	20	N/A

Given the limited spatial extent of the anticipated physical impacts (PMI, RI) and the ability of fish to temporarily avoid areas of adverse noise (see Section 12.2.2.4), further reducing the zone of exposure for TTS, the magnitude of effect can be considered as '**Minor**'. The receptor value of the fish species present in the Cambo field development can be considered as '**Medium**' to '**High**'. Therefore, the resulting predicted effect of the proposed VSP survey, drilling, and vessel operations on fish physiology is '**Minor adverse**', and thus not significant.

12.2.2.4 Behavioural Disturbance of Fish

Very little is known about fish behaviour in the wild when exposed to impulsive signals, as most research has been conducted in the laboratory, where the ability to reproduce natural conditions is limited (Popper & Hawkins, 2019). The majority of available data on behavioural responses to impulsive sounds comes from pile driving activities. However, some information exists about the effects of seismic sources on fish behaviour.

For instance, Løkkeborg et al. (2012) observed changes in horizontal and vertical distributions of pelagic and demersal fishes during and after seismic operations. Despite these disturbances, fish generally return to the affected area within hours or days once seismic activity has ceased (Engås et al., 1996; Engås & Løkkeborg, 2002). Ona et al. (2007) similarly reported avoidance behaviours such as diving and lateral movement in response to approaching vessels. Additionally, several studies have documented reduced catch rates for days following seismic activity, attributed to fish displacement towards deeper waters or away from the insonified zone (Engås et al., 1996; Engås & Løkkeborg, 2002; Slotte et al., 2004). Skalski et al. (1992) also confirmed these responses and showed that sounds as low as 160 dB can trigger a startle reaction in fish.

Continuous anthropogenic noise can also influence fish behaviour in various ways. It may interfere with foraging and predatory-prey interactions through masking or by mimicking prey sounds. Intense continuous sounds may provoke avoidance responses, potentially disrupting migration routes. Masking of spawning sounds, in particular, can significantly impact reproductive success of fish populations (Popper & Hawkins, 2019).

The impact of VSP survey operations on fish is strongly related to their life stage. While adult and juvenile fish are generally capable of detecting and avoiding seismic sources, eggs and larvae may be more vulnerable. Fish can detect impulsive sounds over distances of up to 30 km, yet they seldom react to the sound before it is above a certain threshold. Importantly, evidence suggests that fish disturbed by sound tend to return to an area within hours or days after the activity causing the disturbance ends (Slabbekoorn et al., 2010; Popper & Hawkins, 2019).

Given the very short duration of the planned VSP survey (up to 2 days), the relatively low acoustic energy generated by the vessel operations and the ability of fish to temporarily avoid areas of adverse noise led to considering the magnitude of effect of behavioural disturbance from noise as '**Minor**'. The receptor value of the fish species present in the area of the Cambo field development is judged to be '**Medium**' to '**High**'. Consequently, the resulting predicted effect significance of behavioural disturbance from the noise generated by the VSP survey is '**Minor adverse**', and therefore not significant.

12.3 Assessment of the Requirement for a Wildlife Disturbance Licence

Under the Offshore Marine Conservation (Natural Habitats, and c.) Regulations 2007 (or Offshore Marine Regulations, OMR), as amended by the Offshore Marine Conservation (Natural Habitats, and c.) (Amendment) Regulations 2009, it is an offence to deliberately disturb European Protected Species (EPS; species listed in Annex IV of the Habitats Directive), in such a way that is likely to:

- Impair their ability to survive, to breed or reproduce, or to rear or nurture their young; or in the case of a hibernating or migratory species, to hibernate or migrate; and
- Affect significantly the local distribution or abundance of the species to which they belong.

Ithaca Energy has therefore assessed if the proposed VSP survey would potentially cause a 'disturbance offence' to any EPS and subsequently would require a disturbance licence under these regulations. The potential disturbance caused by seismic activity mainly refers to (underwater) noise.

The EPS include all cetaceans, turtles and sturgeon. In UK waters, the latter two are at the limits of their global distributions (which are centred elsewhere in the western Atlantic or Europe) and only occur in low numbers around the UK. It is therefore extremely unlikely that a significant group of these animals would be present, or that their local abundance or distribution would be significantly affected by marine impacts (JNCC, 2010). Therefore, only cetaceans will be considered from hereon.

As described in Section 12.2.1.3, the VSP survey is not expected to cause any injury to cetaceans, and only a certain level of avoidance responses are expected within 560 metres of the airgun array. Therefore, this assessment will be based on whether any of these behavioural responses could potentially result in a disturbance offence in relation to marine EPS, as defined under regulations 41(1)(b) and 39(1)(b) of the Habitats Regulations and Offshore Marine Regulations, respectively.

It is important to highlight that the estimated range of behavioural disturbance from continuous sounds generated by the MODU/drillship, FPSO, shuttle tanker, and other support vessels exceeds that associated with the airgun array. Therefore, a more precautionary approach is adopted, using the 1,585 m behavioural impact range for continuous vessel noise as the basis for the calculations presented in this section.

Table 12.11 identifies the cetacean species that have been recorded in the Faroe-Shetland Channel and therefore may be present in the wider area during the VSP survey operations. It also specifies the number of individuals per species that can be expected to show any behavioural response (i.e. within a radius of 1,585 m from the seismic array) to represent the worst-case estimate for the area in which potential 'disturbance' effects could be expected to occur. Abundance data has been used from the North Atlantic Sightings Survey (NASS) conducted in 2015 (Pike et al., 2019) and the Small Cetacean Abundance in the North Sea (SCANS) IV surveys (Gilles et al., 2023). Where species were reported during both surveys, the higher abundance estimates has been used. Further information on the cetacean species is presented in Section 5.4.4.

Table 12.11: Numbers of cetaceans present within the disturbance zone of the potential VSP survey operations

Species	Abundance Data (Animals/km^2)	Data Source	Estimated Number of Animals Within 1,585 m Radius of VSP Survey	% of Population in SCANS/NASS Block Affected
Minke whale	0.0116	SCANS IV (Block CS-K*)	0.09	0.02 %
Blue whale	No data	--	--	--
Humpback whale	0.007	NASS 2015 (Block FC)	0.05	0.01 %
Sei whale	No data	--	--	--
Fin whale	0.0644	NASS 2015 (Block FC)	0.51	0.01 %
Atlantic white-sided dolphin	0.070	NASS 2015 (Block FC)	0.55	0.01 %
White-beaked dolphin	0.1352	SCANS IV (Block CS-K*)	1.07	0.02 %
Risso's dolphin	0.0376	SCANS IV (Block CS-K*)	0.29	0.02 %
Killer whale	No data	--	--	--
Long finned pilot whale	0.314	NASS 2015 (Block FC)	2.48	0.01 %
Sperm whale	0.064	NASS 2015 (Block FC)	0.51	0.01 %
Northern bottlenose whale	0.146	NASS 2015 (Block FC)	1.15	0.01
Common dolphin	No data	--	--	--

Species	Abundance Data (Animals/km^2)	Data Source	Estimated Number of Animals Within 1,585 m Radius of VSP Survey	% of Population in SCANS/NASS Block Affected
Harbour porpoise	0.2813	SCANS IV (Block CS-K*)	2.22	0.02

Notes
* = The Cambo field development area is not covered by the SCANS IV survey area. Therefore, abundance data from Block CS-K has been used as the nearest Blocks surveyed near the Cambo field development (approximately 25 km from Cambo FPSO).

Table 12.11 shows that only a few individual cetaceans would potentially be affected by the proposed VSP operation. Of these, harbour porpoise and long-finned pilot whale appear to be relatively more abundant than the other species. As the abundance data in Table 12.11 is based on the mean values, it does not take account of the fact some of these animals live in larger pods, which means that in reality their distribution will be much more clustered. It should also be noted that both species are classed as the most abundant cetacean species living in the water surrounding the UK and the Faroe Islands respectively, as can be seen by the very low percentage of the wider 'population' (based on the estimated total numbers of individuals present in the SCANS IV and NASS 2015 survey areas) being affected. Moreover, it is expected that any impacts would be of short duration and limited to small behavioural changes of a few individual animals. Any affected individuals would also be expected to move back into the area once the seismic activities have finished.

Risso's dolphins and coastal bottlenose dolphins have been identified by the JNCC as the two EPS most likely to require a wildlife disturbance licence for any activity in UK offshore waters that might affect their distribution or abundance (JNCC, 2010). There are no known resident bottlenose dolphins in the vicinity of the proposed VSP survey.

Table 12.11 shows that up to 0.29 Risso's dolphins may show some behaviour response to the VSP operations. This would only affect a very small fraction (0.0021 %) of the wider population. Risso's dolphins are mainly distributed off western and northern coasts of Britain and Ireland and along the continental shelf, with a few records from waters immediately over the shelf break. They are known to use only a portion of UK waters and this is highly variable both seasonally and inter annually. Greatest numbers have been observed from western Scotland with the waters around the Hebrides forming an obvious concentration (BEIS, 2022a). Risso's dolphins are not as common as other dolphin species around Scotland. Although they have been recorded in the Faroe-Shetland Channel, only the waters east of Lewis have been identified as an area where they might be considered as resident (Pollock et al., 2000), well over 200 km from the proposed VSP operations.

As described in Section 12.2.1, any behavioural reactions of any of the cetacean species to underwater sound produced by the VSP survey (or any other activities associated with the proposed field development) are expected to be limited to within a few km. The strongest anticipated response would be the temporary avoidance of certain individuals within a 1,585 m radius. It is believed that the relatively small area, in which this temporary avoidance behaviour

may occur, can be easily avoided by any individual, without causing a serious degree of nuisance to the animals involved or the larger population as a whole.

It seems therefore extremely unlikely that the proposed seismic activity (or any other operations) associated with the proposed field development would adversely affect animals in such a way as to cause 'deliberate disturbance' of a European Protected Species, as such, Ithaca Energy believes it is unnecessary to apply for a wildlife disturbance licence.

12.4 In-combination, Cumulative and Transboundary Impacts

Noise is transmitted through water very efficiently and may be detectable over many kilometres from its source. This has led to concern that increasing anthropogenic activity in the sea, and consequent increasing noise levels, may have effects on marine mammals through interruption of their communication and hearing mechanisms. The potential outcomes of having multiple noise sources in the sea include more frequent masking, behavioural disruptions and short-term displacement, although this could potentially be mitigated by a certain level of habituation. Prolonged or repeated disturbance is generally considered to be of more concern than isolated short-term disturbance.

Although there is minimal potential for overlap with noise from existing oil and gas activity, the presence of the MODU/drillship and subsequent FPSO will add to the ambient noise in the Faroe-Shetland Channel, and the adjacent West of Shetland Continental Shelf, which include various sources of industrial noise such as other oil and gas installations and that from shipping and the fishing activity.

The long term, synergistic and cumulative impact of sound sources is not known, and the introduction of additional low frequency noise into the marine environment from the proposed field development should be considered to have the potential to contribute to the overall cumulative effect of anthropogenic generated underwater noise. However, the risks in this instance are considered to be low, for the following reasons:

- Seismic airgun activity will be transitory, lasting only for 1 to 2 days;
- Noise levels generated by the MODU/drillship and FPSO are well below any harmful sound levels; and
- The relatively low number of other anthropogenic sound sources in the wider Faroe-Shetland area means that the potential to interfere with any migration routes in the area will be very low, as there will be ample space available to avoid the noise signature around the proposed field development.

Therefore, the increase in local, mainly low frequency, underwater noise produced by the FPSO and MODU/drillship and the temporary noise generated by the VSP survey are considered to be insignificant. Ithaca Energy is not aware of any other activities taking place concurrently in the immediate vicinity of the proposed field development.

With regard to potential transboundary effects, the proposed VSP survey will be undertaken over 5 km southeast of the UK/Faroe Islands transboundary line. Although underwater sound

produced during the planned seismic activity may have the potential to travel into Faroese waters, at these distances the sound levels will have attenuated to such a low level, that no observable effects would be expected to occur. Underwater sound levels from the MODU/drillship and FPSO will also be much lower, again, to below a level where any observable effects would be expected to occur.

Therefore, no significant cumulative and/or transboundary impacts from noise generated by the MODU/drillship, FPSO, or during the proposed VSP survey associated with the proposed field development are expected. No potentially significant in-combination effects were identified which would justify further assessment, beyond the individual effects that have already been considered in this section, as this would not alter the conclusions already reached.

12.5 Mitigation Measures

The amount of underwater sound generated during the VSP survey will be kept to a minimum where possible. The main priority will be to minimise the time over which sound energy is emitted into the marine environment during the proposed seismic airgun activity (1 to 2 days). Therefore, any noise associated with the operations will be transitory.

The planned VSP survey will be conducted in accordance with the JNCC Protocol for minimising risk of injury to marine mammals from seismic surveys (JNCC, 2017), at all times. This will include the use of a trained Marine Mammal Observer (MMO) to undertake cetacean monitoring duties before any VSP survey operations commence and the use of "soft start" procedures.

Throughout the proposed field development, logistics will be optimised to minimise unnecessary or low payload helicopter flights and vessel sailings.

12.6 Conclusions

Anthropogenic noise from shipping, and potentially also from existing oil and gas installations, is currently believed to be the main source of anthropogenic background noise in the area of the proposed Cambo field development. The addition of (mainly) low frequency noise generated by the MODU/Drillship and, subsequently, by the FPSO and their support vessels will add to the overall anthropogenic footprint in the area. No good practice guidelines exist in the UK for drilling or production activities since these are thought to be of low concern in terms of disturbance to cetaceans (JNCC, 2010). Consequently, these are not expected to cause any significant impacts on marine mammals potentially present in this area.

In addition, the potential VSP survey for the optional appraisal well at DC3 may cause temporary avoidance responses and other, more subtle, behavioural reactions in cetaceans within a few hundreds of metres of the seismic operations for the duration of the VSP survey. Given the short duration of these operations (1 to 2 days), any such effects are expected to be transient and of '**Minor adverse**' significance and, consequently, are not considered to be significant.

13. Waste Management

The management of waste produced offshore on the United Kingdom Continental Shelf (UKCS) is regulated through a framework of international and national legislation. Waste from offshore vessels and facilities is primarily regulated by the Merchant Shipping (Prevention of Pollution by Sewage and Garbage of Ships) Regulations 2008. These Regulations implement both the revised Annex IV of MARPOL 73/78 – Regulations for the Prevention of Pollution by Sewage from Ships, and the Annex V of MARPOL 73/78 (including amendments) – Regulations for the prevention of Pollution by Garbage from Ships. These Regulations prohibit the disposal of any garbage (including plastics) and galley waste (except for ground food waste to < 25 mm and treated sewage) from any offshore installations or vessels. Once transported onshore, waste management is regulated by the Environment Protection Act 1990, which sets out Duty of Care requirements for the containment, transfer, handling, and recording of all onshore waste through appropriately licensed carriers holding a Waste Carrier Registration.

All wastes associated with the Cambo field development will be managed in accordance with Ithaca Energy's Waste Management Procedure and via the existing waste management contracts. This procedure establishes the controls required to manage the hazards associated with the transportation and disposal of waste from offshore sites as well as the processes and verification activities necessary to ensure legal obligations are satisfied.

Waste handling onboard the mobile offshore drilling unit (MODU) and any associated support vessels will be the responsibility of the MODU/vessel contractors. However, Ithaca Energy will ensure that the collection, handling, and disposal of all waste generated by the Cambo field development is achieved, in compliance with current environmental legislation and Ithaca Energy's procedures.

13.1 The Waste Hierarchy

Ithaca Energy is committed to reducing waste production and to managing all produced waste by adhering to the waste hierarchy as presented in Figure 13.1. The waste hierarchy ranks waste management options according to the best environmental outcome, taking into consideration the lifecycle of the material. The lifecycle of a material is an environmental assessment of all the stages of a product's life from-cradle-to-grave (i.e. from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling). Waste will only be disposed of if it cannot be prevented (also referred to as reduced), re-used, recycled or recovered.

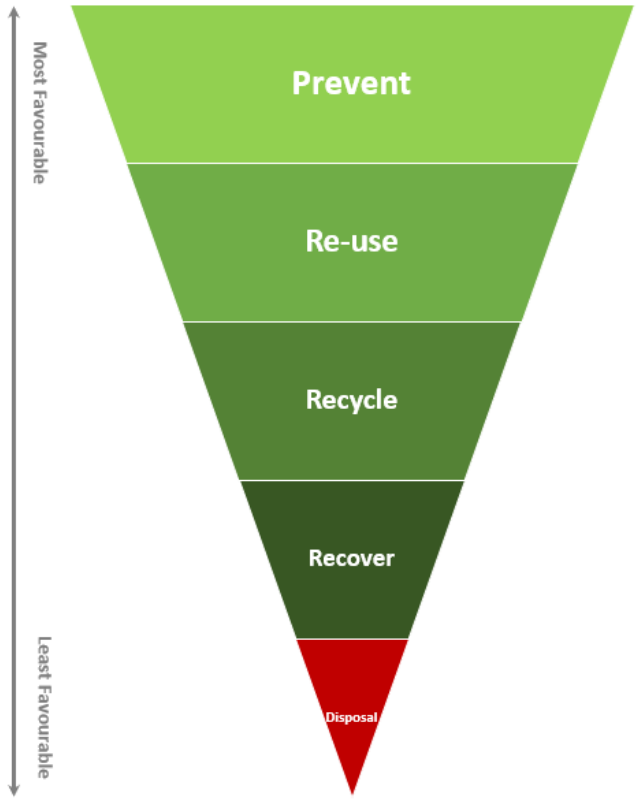


Figure 13.1: Waste hierarchy

In its simplest form, the waste hierarchy gives top priority to preventing (or reducing) waste. When waste is created, it gives priority to preparing it for reuse, then recycling, then other recovery, and last of all disposal (i.e. landfill). For example, one tonne of food waste in landfill produces 450 kg CO_2eq (equivalents), whereas preventing one tonne of food waste saves 3,590 kg CO_2eq. The benefits of selecting options higher up the hierarchy also extend beyond carbon savings and include reduced water consumption, protection of important raw materials, creation of jobs, and other economic opportunities (Scottish Government, 2017).

13.2 Waste Disposal Management

The eventual disposal of any waste is intrinsically related to its nature. All waste produced as part of the development will be minimised through appropriate procurement controls and will be properly segregated for recycling, disposal, and treatment. Bulk wastes generated offshore will be segregated by type, and periodically transported to shore for disposal or recycling in an auditable manner through authorised waste contractors.

The amounts and disposal routes of all atmospheric emissions, liquid discharges, and solid wastes will be recorded in the UK Environmental Emissions Monitoring System (EEMS) according to the following categories:

- Group I: Special waste, such as oils, paints, adhesives, solvents, surplus chemicals, etc., and these are mainly recycled;
- Group II: General waste, including non-hazardous workover / completion / drilling fluids, brines, galley waste, accommodation waste, compactor waste, and much of this has to go

to landfill. Segregated materials such as scrap metal, plastics, aluminium cans, paper / cardboard, glass, cooking oil, and clean wood are recycled;

- Group III: Other waste, including asbestos, clinical materials, and explosives;
- Group IV: Backloaded cuttings, such as oil-based mud (OBM) or synthetic based mud (SBM) cuttings backloaded for treatment, as well as water based mud (WBM) drill cuttings backloaded for disposal onshore. In this group are also included any solid material (e.g. powder or stabilised products) generated by the treatment process, oil recovered from the backloaded cuttings through the treatment process, and water separated from the oil and solids through the cuttings treatment process; and
- Group V: Naturally occurring radioactive material (NORM) from mineral scales which build up in processing equipment and pipework (generally from production installations only).

Any onshore waste disposal will be undertaken at appropriate licensed sites through suitably licensed waste disposal contractors.

13.2.1 Waste Sources and Management

Ithaca Energy is responsible for ensuring that waste is transferred to disposal contractors in possession of a Waste Carrier Registration. All controlled waste being transferred onshore is required to have a completed Transfer Note, whilst special waste requires a Consignment Note. These Notes provide details on the type and quantity of waste that is being transferred, the parties involved in the transfer of waste, the category of authorised person in receipt of the waste, licence numbers, and time, place and date of transfer.

13.2.1.1 Vessel Waste

Waste will be generated onboard all vessels associated with the proposed activities including the MODU, support vessels and subsea installation vessels. All wastes will be managed in compliance with the framework of Regulations discussed above and in line with individual vessel specific Waste Management Plans (WMPs). Generally, waste will be segregated and stored in suitable, labelled containers on the vessels and will be discharged in line with MARPOL 73/78 requirements or transferred to shore in skips and / or containers where it will be disposed of appropriately.

Offshore vessels of 400 gt and above, and every ship certified to carry 15 or more persons, must have a Garbage Management Plan (GMP) (per guidance in Merchant Shipping Notice No.1807) and Garbage Record Book. Solid domestic waste will normally be compacted with a garbage compactor, placed in disposal bags and returned to the mainland in waste skips. Open skips will be netted and lidded skips will be used for drill cuttings (if required). Separate storage areas will be provided for solid and liquid waste that can be reused. Waste storage areas will be well ventilated and bunded with drainage to appropriate storage or treatment areas. Hazardous waste containers will be covered to reduce rainwater contact in the containment structure. Furthermore, segregation of recyclable materials will be implemented to avoid contamination and consequent reduction of the quality of recycled products.

The Floating Production Storage and Offloading vessel (FPSO) will be designed with adequate space for waste storage and segregation facilities, including laydown areas for skips and deck space for other waste storage receptacles.

13.2.1.2 Drilling Waste

Drilling rigs generate various waste products during routine operations (e.g. drill cuttings, excess cement, used drilling fluids and chemicals), in addition to waste generated from the everyday running of the MODU (e.g. general waste, food waste and sewage). Wastes will be minimised by use of appropriate procurement controls, and all wastes will be segregated for recycling, disposal, and / or treatment. The appointed waste management contractor will supply monthly reports of waste sent to shore and will complete Controlled Waste Transfer Notes as required, and records of monthly disposals will be maintained. Waste Management Duty of Care audits will also be carried out.

Oily waste will be generated on the MODU by a variety of sources, including waste engine and hydraulic oils. All waste oil will be held in designated storage tanks onboard the MODU. The volumes of waste oils kept onboard will be kept to minimum before being transferred to shore, keeping the possibility of spillages to a minimum. No sludge or waste oil will be discharged to sea.

13.2.1.3 Installation and Commissioning Waste

Several waste streams are expected to arise during installation and commissioning including scrap metal, wooden crates, etc. All wastes will be segregated in accordance with Ithaca Energy's Waste Management Procedure and Controlled Waste Transfer Notes will be completed.

13.2.1.4 Production Waste

Controlled Waste Transfer Notes will continue to be completed as required and records on monthly waste disposal activities will be maintained.

13.2.1.5 Decommissioning Waste

Any waste generated during the decommissioning stage and the most appropriate disposal option(s) will be identified and discussed in a dedicated WMP. Where possible, materials will be sold for reuse or recycled in accordance with the waste hierarchy. All recovered waste will be brought to shore to a licenced decommissioning facility. It is expected that the majority of the recovered materials will be reused or recycled.

13.3 Mitigation Measures and Best Practice

The management of offshore waste generated on the UKCS is strictly regulated, ensuring a high level of mitigation from the outset, and as described above. Ithaca Energy ensures successful implementation of the mitigation and industry best practice measures regarding waste management as follows:

- Application of the Waste Hierarchy to all produced waste;
- Provision of adequate space onboard the MODU and FPSO for waste storage and segregation facilities including laydown areas for skips and other waste receptacles;
- Compliance with Ithaca Energy's WMP and use of a GMP for the management of waste produced from vessels;
- Compliance with Ithaca Energy's Waste Management Procedures for waste produced during the proposed development activities;
- Segregation, transfer onshore and disposal of waste through licensed contractors and sites; and
- Reporting of all waste generated offshore in the UK EEMS.

13.4 Conclusion

Several different waste streams will be generated throughout the development's lifespan. Waste management will be undertaken in compliance with current environmental legislation and the company's own waste procedures which includes the waste hierarchy, as described above. The management of offshore waste generated on the UKCS is strictly regulated and the UK has well-established infrastructure in place to manage this waste effectively. Therefore, no significant impacts (including in combination, cumulative or transboundary impacts) are anticipated as a result of the Cambo field development.

14. Accidental Events

As well as assessing operational processes, the Environmental Impact Assessment (EIA) process also examines potential accidental events that may result in impacts upon the environment and for which mitigation measures may be implemented. The following issues and concerns were raised during the Environmental Issues Identification (ENVID) workshop and informal consultation and are considered in this section on the potential impacts from accidental events that could occur during operations at the proposed Cambo field development.

- Impacts on marine environment, the coastal environment and other users of the sea by large, medium or small hydrocarbon spills to sea;
- Impacts on seabed communities as a result of the loss of the Floating Production, Storage and Offloading Vessel (FPSO), installation vessels, support vessels, the Mobile Operated Drilling Unit (MODU) or a helicopter.

The remainder of this section describes the potential impacts of hydrocarbon spills (Sections 14.1 to 14.7) and from the loss of the FPSO, installations vessels, support vessels, the MODU or a helicopter (Section 14.8).

14.1 Sources of Hydrocarbon Spill

The risk of an accidental hydrocarbon spillage to sea is often one of the main environmental concerns associated with oil-industry activities. Spilled oil at sea can have a number of environmental and economic impacts, the most conspicuous of which are on seabirds and coastal areas. The severity of the impacts depend on many factors, including the volume and type of hydrocarbon spilled, the sea and weather conditions at the time of the spill, and the oil spill response.

The following events associated with the proposed field development have been identified as having the potential to cause an oil spill:

- Uncontrolled well blow-out;
- Loss of the FPSO inventory;
- A fuel oil spillage from an installation vessel, support and supply vessel or the MODU;
- An oil spillage when carrying out offloading operations to shuttle tanker;
- Loss of inventory of an infield flowline or riser.

The Cambo field development will produce crude oil with a density 902 kg/m^3 to 916 kg/m^3. A crude oil spill from either a well blow-out or a catastrophic failure of the FPSO storage tanks have been identified as the two worst-case oil spill scenarios, that could potentially result in a Major Environmental Incident (MEI).

14.1.1 Potential Crude Oil Spillages

14.1.1.1 Uncontrolled Well Blow-out

During drilling operations, a well blow-out would represent the largest potential source of a large hydrocarbon spill. For a blow-out to occur, the primary well control element, the hydrostatic pressure exerted by the drilling mud, would have to be overcome by the inflowing hydrocarbons. The secondary well control measure, the blow-out preventer (BOP), would also have to fail in closing off the well. The actual flow rate and duration of any such event, and hence the severity of the incident, are dependent upon the pressure and geology of the well, which vary with each well.

The flow rate encountered during an uncontrolled blow-out event may be very different from that expected during production, as there may be no equipment or other measures in place to restrict the flow. To model the potential worst-case blow-out scenario, it was assumed that there would be no physical restriction to the flow inside the well, such as drill string or tubing obstructing the wellbore, chemical build-up coating in the wellbore, a disconnected riser, or damaged wellhead and well control equipment on top of the well.

14.1.2 Potential Diesel (Fuel Oil) Spillages

Diesel will be the main fuel used for power generation during the proposed drilling operations and will be the largest volume of hydrocarbons stored on the MODU during the drilling operations. Similarly, the FPSO will have diesel storage capacity to run its diesel consumers. The diesel will be split between multiple fuel oil bunker tanks. The worst-case diesel spill scenario is considered to be the complete loss of the diesel inventory from all of the fuel tanks.

Smaller diesel spills can result from equipment failures, such as the rupture of pipes or open valves. As explained in Section 14.2.2, small spills most frequently occur during bunkering operations and are generally caused by hose failures. Diesel will be supplied from a supply vessel to the FPSO / MODU on regular intervals, via a flexible hose. As the hose is suspended between the two vessels, there is the potential for a direct diesel release to sea, if the hose or any of its connections are damaged during the bunkering operations.

14.1.3 Other Potential Sources of Oil

Lubricating and hydraulic oils are stored separately in tanks or sealed drums. Storage tanks for lubricating oil range in size, but each will normally contain a maximum of 15 m^3, while hydraulic oils are stored in much smaller 1 m^3 tanks. Additional oils may be transported and stored in sealed 0.025 m^3 or 0.21 m^3 drums or 1 m^3 tote tanks, all of which will be stored in dedicated, bunded storage areas, with oil spill kits located nearby. Up to approximately 12 m^3 of aviation fuel, contained in 2.7 m^3 or 4.0 m^3 helifuel tanks, will be held in a bunded area.

Waste oil will be generated on the FPSO and the MODU from a variety of sources, including waste engine, gear and hydraulic oil. These waste oils will be held in designated storage tanks

and their volumes kept to a minimum before being transferred to shore at regular intervals. Therefore, the possibility of a spillage from any of these sources is very small.

The amounts of lubricating, hydraulic and waste oil stored onboard the FPSO and the MODU will be very small in comparison to the main fuel supply. The probability of any significant spillages from any of these sources is considered to be minimal, as the containers are relatively small, sealed and stored in bunded areas. Therefore, the risk to the environment from these oils is regarded as negligible and is not considered further within this section.

14.2 Likelihood of a Hydrocarbon Spill from the MODU

Historical data, covering the period between January 1990 and December 2024, indicate that the possibility of a large hydrocarbon spill from a MODU operating on the United Kingdom Continental Shelf (UKCS) is very low. As shown in Figure 14.1 (Fugro, 2025c), most spillages from MODUs are attributable to release of hydraulic/lube oils (241), crude oils (236) and Oil Based Muds (OBM)/Base oils (236). However, these are typically quite small spillages. Looking at the overall volume of hydrocarbons spilled over this period, it can be seen that OBM spillages make up nearly 50 % of the overall volume spilled. OBMs will not be used during the proposed Cambo wells, removing the risk of this type of spill occurring but Low Toxicity Oil Based Muds (LTOBM) may be used in the drilling of the lower well sections. If LTOBM is used in the drilling operations the cuttings will either be collected on the MODU and shipped to shore for appropriate treatment and disposal or thermally treated offshore reducing any remaining oil residue in the cuttings before being discharged to sea (Section 4.4.3).

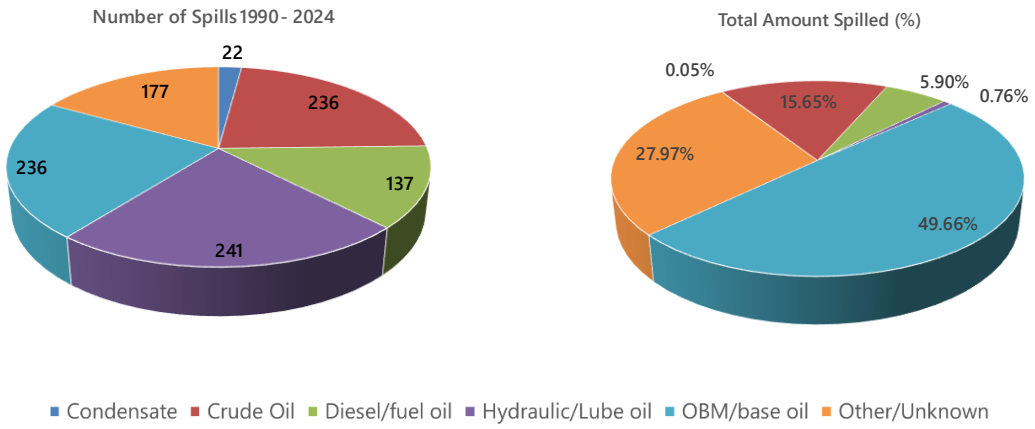


Figure 14.1: Oil spills on the UKCS from MODUs between 1990 and 2024 (Fugro, 2025c)

Using data presented in HSE (2007), it can be calculated that on average, the probability of an oil spill from a MODU is 0.0015 spills per rig day, or one spill every 647 rig days.

As well as the frequency of spills, the size of a potential hydrocarbon spill is also very important in spill response planning. Figure 14.2 illustrates the proportion of oil spills from MODUs which fall into each of three size categories. The dataset shows that the majority of spills (81.5 %) are

smaller than 1 tonne (Fugro, 2025c). It is expected that the response to a spill of this size could be undertaken and fully managed by the MODU itself, requiring only monitoring while the slick evaporates and disperses naturally.

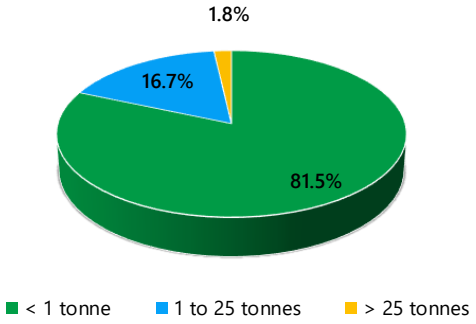


Figure 14.2: Percentage of hydrocarbon spills form MODUs by size, between 1990 and 2024 (Fugro, 2025c)

Based on the probability of an oil spill of any size from a MODU being one spill every 647 days (0.0015 spills per rig day) and 81.5 % of spills being smaller than 1 tonne, it is calculated that the probability of an oil spill of less than 1 tonne from a MODU is one spill every 794 rig days.

The probability of an oil spill of between 1 tonne and 25 tonnes from a MODU is one spill every 3,874 rig days (i.e. 0.00025 spills per rig day). The probability of an oil spill larger than 25 tonnes from a MODU is one spill every 35,940 rig days (i.e. 0.000027 spills per rig day).

The proposed Cambo wells (water injection, production and optional appraisal) are estimated to take between 80.5 days and 87.7 days to drill and complete (per well). Therefore, by extrapolating the spill probabilities calculated above, the chance of a small spill (i.e. less than 1 tonnes) during drilling operations ranges from 10.14 % to 10.92 % per well. Similarly, the probability of a spill over 1 tonne in size is one spill per 3,497 days (i.e. 0.00028 spills per rig day). This translates to a probability of 2.30 % to 2.48 % for any of the proposed Cambo wells.

14.2.1 Uncontrolled Well Blow-out

The probability of an uncontrolled well blow-out event occurring is very low. Well blow-outs resulting in the uncontrolled release of hydrocarbons have happened too infrequently on the UKCS for a meaningful analysis of the historic frequency to be carried out. The following summarises historic well control events on the UKCS.

Prior to 1990, only two significant uncontrolled blow-outs occurred in the North Sea. These events occurred during drilling operations on the West Vanguard semi-submersible on the Norwegian continental shelf and on the Ocean Odyssey semi-submersible on the UKCS, during 1985 and 1988 respectively (DTI, 2007). Both blow-outs involved gas and did not result in hydrocarbon spills to sea. Moreover, lessons learnt from these events resulted in major legislative and operational changes for offshore drilling on the UKCS to prevent such events from happening again.

Between 1990 and 2007, a total of 341 well incidents (i.e. well problems and loss of well control) were recorded from MODUs and floating production installations, including FPSOs. These incidents included several issues of varying severity, but only 16 resulted in loss of well control. This translates to 0.000034 well control incidents per rig day, or one incident every 29,631 rig days. Furthermore, none of the 16 recorded incidents resulted in an uncontrolled well blow-out resulting in a crude oil spill of any size (OGUK, 2009).

The most recent well control incident in the North Sea involved a gas and condensate blow-out from Well 22/30c-G4, located close to the Elgin Platform, in March 2012. This incident resulted in the temporary cessation of production from the Elgin/Franklin area. Ithaca Energy will review the lessons learnt from this incident, together with any lessons learned from subsequent drilling campaigns, when planning the drilling operations at the Cambo field.

14.2.2 Diesel Spills

Diesel spills from mobile drilling units account for 5.90 % of all oil spilled on the UKCS from MODUs (Figure 14.1). Diesel will be the main fuel used for power generation during the proposed drilling operations and, therefore, will be the largest volume of hydrocarbons stored on the MODU. Historical oil spill data indicate that the probability of a diesel spill is 0.0002 spills per day, or one spill in every 4,318 days. When extrapolating this probability to the Cambo wells, this equates to a probability of between 1.86 % and 2.01 % of a diesel spill occurring during the drilling of each well (Fugro, 2025c; HSE, 2007).

Spill records indicate that most diesel spills tend to occur during bunkering operations and that they are mostly caused by hose failures. Therefore, the volumes of diesel spilled tend to be relatively small. For example, of the 137 recorded diesel spills, 128 (93 %) were less than 1 tonne (Fugro, 2025c). If a diesel spill of this size were to occur, it is likely that onsite response personnel and equipment would be required to control the incident, due to the tendency of diesel to evaporate and disperse relatively quickly from the sea surface (see Section 14.4). Only three of the recorded diesel spills were greater than 5 tonnes, and each of these also occurred during bunkering operations.

The worst-case scenario, complete loss of the diesel inventory, will only occur as a result of a major accident, such as a catastrophic collision with another vessel. The probability of such an event occurring is very low, particularly with the very low vessel traffic in this area (see Section 5.7.4).

14.3 Likelihood of a Hydrocarbon Spill from the FPSO

Historical data, covering the period between January 1990 and December 2024, indicate that the possibility of a large hydrocarbon spill from an FPSO operating on the UKCS is very low. In contrast to spillages from MODUs, the largest number of spills from FPSOs are from crude oil (Figure 14.3). Crude oil spillages make up almost 89 % of the overall volume spilled. However, individual spills are typically small, with 1,033 (94.5 %) out of 1,093 recorded spills being less than 1 tonne (Figure 14.4).

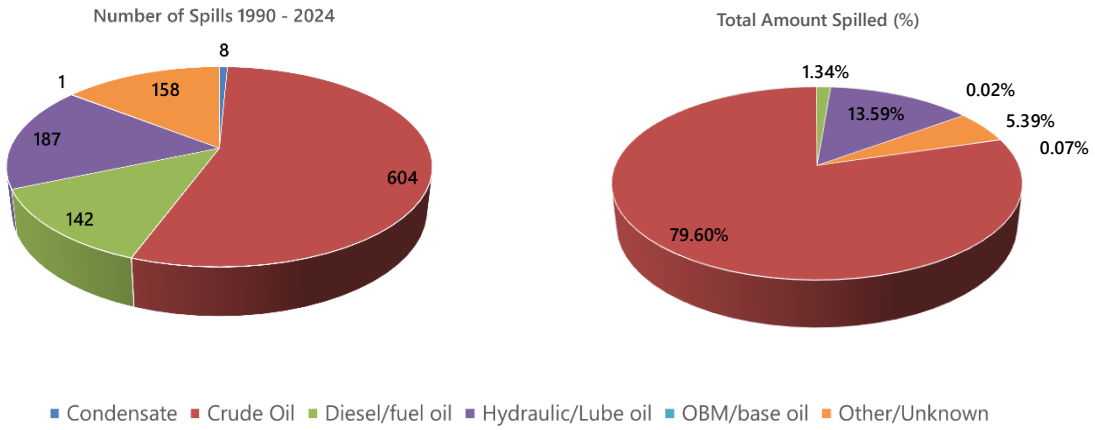


Figure 14.3: Oil spills on the UKCS from FPSOs between 1990 and 2024 (Fugro, 2025c)

Using data presented in HSE (2007), it can be calculated that on average, the probability of an oil spill from a FPSO is 0.01 spills per day, or one spill every 97.7 days. It should be noted that the vast majority (94.5 %) of FPSO spills are small. It is expected that the response to a spill of this size could be undertaken and fully managed by the FPSO, itself, requiring only monitoring while the slick evaporates and disperses naturally.

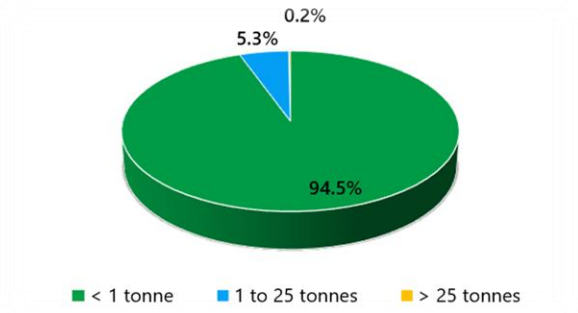


Figure 14.4: Percentage of hydrocarbon spills from FPSO by size between 1990 and 2024 (Fugro, 2025c)

14.4 The Fate and Behaviour of a Hydrocarbon Spill at Sea

Oil characteristics, spill location and the wave, wind and current conditions all govern the fate of spilled hydrocarbons. The behaviour of hydrocarbons when released from the sea surface and from the seabed are described in the following section. During the proposed drilling operations, it is expected that the most likely release point for a release of reservoir hydrocarbons (crude oil and gas) would be at the seabed. Meanwhile, the most likely release point for a spill of crude from the FPSO storage tanks would be from the sea surface.

The fate of hydrocarbons spilled at sea is relatively well understood. As soon as oil is released, the weathering process begins and the oil begins to move across the sea surface. Oil characteristics, spill location and wave and wind conditions govern the fate of the spilled oil. These processes are described below.

14.4.1 Oil Spill Movement

14.4.1.1 Spreading

Due to the influence of gravity, oil starts to spread out over the sea surface as soon as it is spilled. Oil slicks can spread very quickly to cover extensive areas of the sea surface, the speed of which depends mainly on the viscosity of the oil. Lighter oils spread out more quickly than heavier crudes. Although a spill will spread quickly in the first few days, the processes of evaporation and dispersion quickly remove the lighter, more volatile and water soluble, fractions of a slick from the sea surface. Then, as only the heavier, more viscous fractions are left, slick spreading will slow down.

Initially an oil spill will spread out as a single slick, covering an increasingly larger area while the slick becomes correspondingly thinner. However, as the slick spreads further, it will start to break up into smaller breakaway slicks due to the wind and water movement. Wind and wave conditions West of Shetland can be regarded as very dynamic, due to a combination of the relatively high wind speeds and increased water movement, created by a combination of the wind speed and the large fetch across the Atlantic Ocean. As such, it is expected that a large oil slick in this area would tend to break up very quickly into smaller patches.

14.4.1.2 Direction of Movement

Wind and surface current speed and direction are the main parameters influencing the movement of an oil slick. Any oil slick will travel roughly at the same speed and direction as the surface water current, while the prevailing wind drives a slick downwind at 3 % to 4 % of the wind speed.

The ocean current regime in the Faroe-Shetland Channel is complex (Section 5.3.1), due to the bathymetry of the area and the interaction of a number of different water masses. On a broad scale, cold, dense bottom water from the Arctic Basin flows southwest along the channel floor, whilst warmer Atlantic water flows over the top of it to the northeast. This suggests that any slick occurring in the surface waters of the Faroe-Shetland Channel would move with the dominant current to the northeast.

Although offshore winds West of Shetland may blow from any direction, they most frequently originate from the southwest (Section 5.3.2). This also suggests that a slick occurring on the sea surface would generally be directed to the northeast by the wind.

14.4.2 The Weathering Process

When oil is released into the marine environment it undergoes a number of physico-chemical changes, some of which assist in the degradation of the spill, while others may cause it to persist. These changes are dependent upon the type and volume of oil spilled, and the prevailing weather and sea conditions. An overview of the main processes influencing the fate and behaviour of spilled oil at sea is given in Figure 14.5. Evaporation and dispersion are the two main mechanisms that act to remove oil from the sea surface.

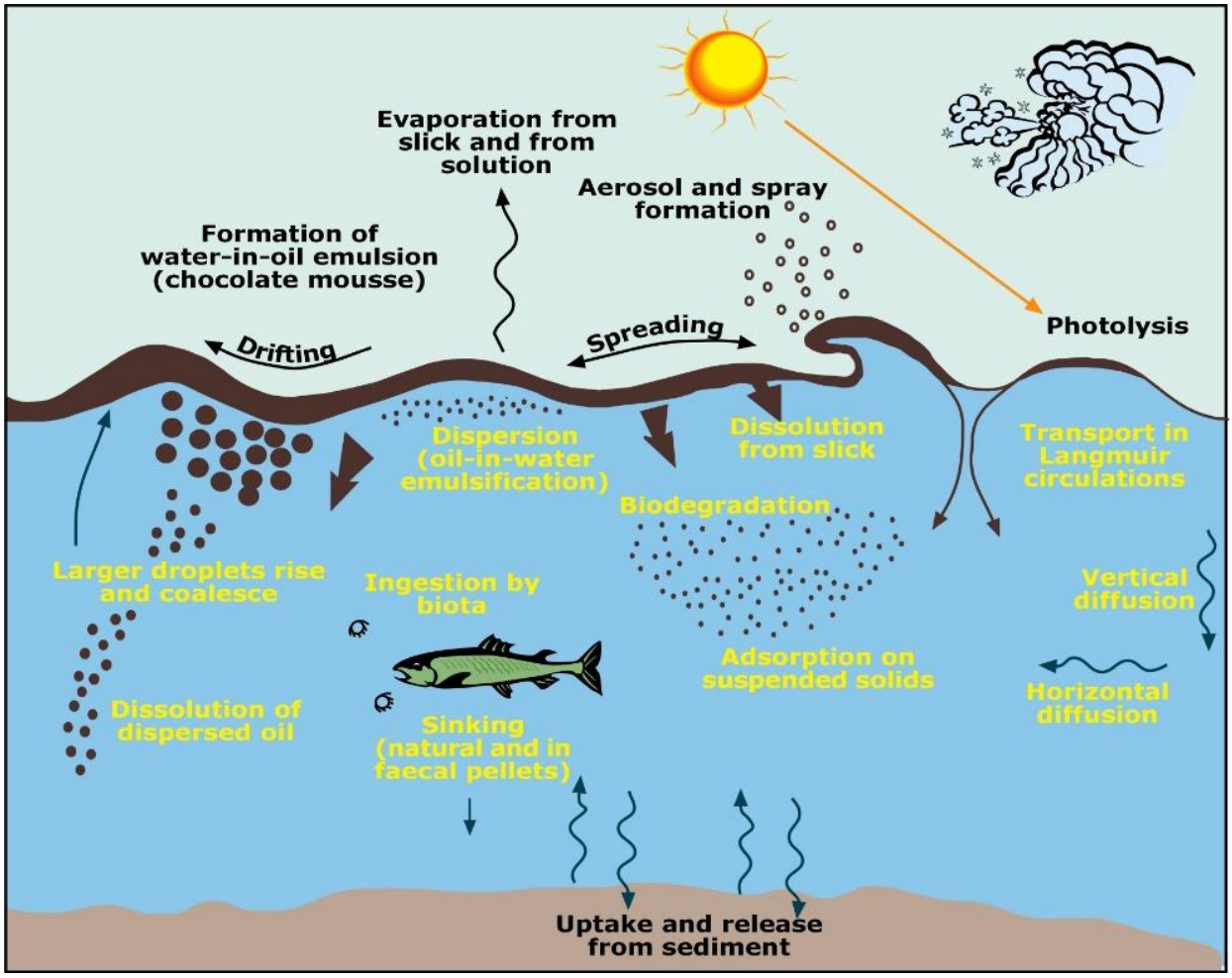


Figure 14.5: Fate and behaviour of spilled oil at sea

14.4.2.1 Evaporation

Following a hydrocarbon spill, evaporation is the initial predominant mechanism of reducing the mass of oil, as the light fractions (including aromatic compounds such benzene and toluene) evaporate quickly. Evaporation can cause considerable changes in the density, viscosity and volume of the spill. If the spilled oil contains a high percentage of light hydrocarbon fractions, a large part of it will evaporate relatively quickly (within a few hours) in comparison to the heavier components of oil which will remain at sea (Keramea et al., 2021; Mishra & Kumar., 2015).

Diesel displays very high evaporative losses upon exposure to air. Under ideal environmental conditions, i.e. a warm, sunny day with only moderate wind, a large proportion of the spill volume may be lost by evaporation in the first few hours after release. The evaporation process will be enhanced by warm temperatures and moderate winds.

14.4.2.2 Dispersion

After the light fractions have evaporated from the slick, natural dispersion becomes the dominant mechanism in reducing slick volume. The speed at which oil disperses is largely dependent upon the nature of the oil and the sea state. Lighter and less viscous oils tend to

have more water soluble components, allowing them to mix and remain suspended within the water column.

The process of dispersion is dependent upon waves and turbulence at the sea surface, which can cause a slick to break up into fragments and droplets of varying sizes. This turbulence mixes these droplets into the upper levels of the water column, where some of the smaller droplets will remain suspended, while the larger ones will tend to rise back to the surface. Therefore, rough seas will break up a slick and disperse the oil at a faster rate than calm seas. There have been incidences of large oil spills being broken up and dispersed into the water column during large storm events, with little visible effect on the surrounding environment. As oil droplets are dispersed into the water column, the oil has a greater surface area which encourages the natural processes of dissolution, biodegradation and sedimentation.

Water movement at the sea surface is affected by wind speed. The West of Shetland area is a very active environment, with relatively high average wind speeds. Although wind speeds are generally reduced during the summer months, the sea state still reaches a Beaufort Force 5, a fresh breeze generating moderate waves, or greater for around 39 % of the time. Water movement and wave size is also related to fetch, the distance over which the wind can blow without being interrupted. As the prevailing south-westerly winds blow uninterrupted across the Northeast Atlantic to the proposed Cambo field development, the waves this wind generates have the potential to become very large in size.

14.4.2.3 Emulsification

Emulsification is the process by which water is being mixed into the oil (Mishra et al., 2015). This water-in-oil emulsion in the form of suspended small droplets is often referred to as a "mousse" (Keramea et al., 2021). The rate at which this happens, and the type of emulsion formed, is dependent upon the oil type, sea state and the thickness of the oil slick (Keramea et al., 2021). Large, thick oil slicks tend to form water-in-oil emulsions, while smaller thinner slicks tend to form oil-in-water emulsions that usually disappear by natural dispersion. In practice, usually only one of the two processes will dominate.

When a water-in-oil emulsion (chocolate mousse) is formed, the overall volume of the slick increases significantly, as it may contain up to 80 % to 90 % water (Dachev, 2022). This chocolate mousse will form a thick layer on the sea surface reducing slick spreading and inhibiting natural dispersion. The formation of this thick layer causes the surface area available to weathering and degradation processes to diminish, which can make 'chocolate mousses' difficult to break up using dispersants (Dachev, 2022; Keramea et al., 2021). In their emulsified form, and with their drastically increased volume, they can also cause difficulties for mechanical recovery devices. Asphaltenes, which are present in greater concentrations in crude oil than diesel, tend to enhance the formation of stable water-in-oil emulsions (Dachev, 2022). Therefore, a water-in-oil emulsion is therefore unlikely to occur in diesel spills.

14.4.3 Oil Spill Modelling

The amount of time a hydrocarbon spill remains on the sea surface before becoming insignificant, and the extent to which it spreads from the point of release, can dictate the severity of impacts on the marine life, particularly seabirds. Whether it reaches the shore is also a major consideration in impact prediction, due to the sensitivity of the nearest coastlines at Shetland and Orkney, and the additional clean up resources required. Both deterministic and stochastic oil spill modelling has been conducted to provide information on whether a spill might beach, and if so, how much time this would take. In view of this, the end points for the oil spill risk assessment are considered to be:

- Probability of oil reaching a shoreline, or crossing a median line to reach international waters;
- Minimum time taken for oil to reach a shoreline or crossing a median line to reach international waters.

Stochastic oil spill modelling has been conducted to assess these two criteria. Stochastic oil spill modelling is based on actual statistical wind speed and direction frequency data and provides a probability range of sea surface oil and beaching, representative of the prevailing conditions.

All modelling has been undertaken using SINTEF's Oil Spill Contingency and Response (OSCAR) model (Version 9.0.1). As discussed in Section 14.1, the two scenarios which may result in a large release of hydrocarbons to sea are an uncontrolled well blow-out, or a catastrophic failure of the FPSO storage tanks. Both scenarios would result in the release of a large crude oil spill. Modelling has therefore been undertaken for both of these scenarios.

Oil spill modelling for both scenarios has been carried out for all four seasons i.e. winter, spring, summer and autumn. This provides a range of risk profiles throughout the year in the event of a delay to operations.

14.4.3.1 Uncontrolled Well Blow-out

The parameters used in the modelling on an uncontrolled well blow-out are detailed in Table 14.1. The results of the well blow-out modelling scenario are provided in Table 14.2.

The minimum arrival time of surface oiling is shown in Figure 14.6 and the probability of surface oiling in Figure 14.7. It should be noted that surface oiling is shown with a thickness threshold of 0.3 micro metre (µm) (equal to 0.0003 mm), in accordance with OPRED's (Offshore Petroleum Regulator for Environment and Decommissioning) oil spill modelling requirements. Potential impacts relating to the modelling results are described in Section 14.5.

Table 14.1: Well blow-out modelling parameters

Well Blow-out Parameters								
Loss from Well/FPSO/Rig/Other	Well			Instantaneous Loss?	No			
Worst Case [m^3]	109,948 m^3 / 30 days			Will the Well Self-Kill?	No			
Flow Rate [m^3/day]	Day 0 to 5: 5,239 m^3 Day 6 to 10: 3,806 m^3 Day 11 to 20: 3,356 m^3 Day 21 to 30: 3,117 m^3							
Justification for Predicted Worst Case Volume	It would be expected to take 30 days to install the well capping device							
Location								
Spill Source Point	60° 48' 34.453" N, 4° 10' 31.998" W							
Installation / Facility Name	Well P3		Quad / Block	204/10a				
Hydrocarbon Properties								
Hydrocarbon Name	Cambo							
Assay Available	Yes		Was An Analogue Used for Spill Modelling?	Yes				
	Name	ITOPF Category	Specific Gravity	API Gravity	Viscosity [cP]	Pour Point [°C]	Wax Content [%]	Asphaltene Content [%]
Hydrocarbon	Cambo crude	3	0.918	25.4	600	-36	8.4	0.35
Analogue	Schiehallion	3	0.899	25.9	180	3	7.0	0.36
Metocean Parameters								
Air Temperature (°C)	2°C to 15°C		Sea Temperature (°C)	7°C to 15°C				
Wind Data	2 years' (2012 to 2013) Oil & Gas UK* Data from the European Centre for Medium-Range Weather Forecasts (ECMWF) Wind Data							
Current Data	2 years' (2011 to 2013) Oil & Gas UK* Data: Shelf daily currents							
Modelled Release Parameters								
Surface or Subsurface	Subsurface		Depth [m]	1,082 m				
Release Duration [days]	30 days		Instantaneous?	No				
Persistence Duration [days]	45 days		Release Rate [m^3/hour]	Day 0 to 5: 218 m^3 Day 6 to 10: 159 m^3 Day 11 to 20: 140 m^3 Day 21 to 30: 130 m^3				
Total Simulation Time [days]	45 days		Total Release [m^3]	109,948 m^3				
Oil Spill Software								
Name of Software	MEMW-OSCAR		Version	11.0.1				

Notes
* - Now Offshore Energies UK
Source: OSRL, 2020a

Table 14.2: Well blow-out modelling results

Well Blow-out Modelling Summary				
Spill Scenario/Descriptor	Cambo P3 well blow-out			
Median Crossing				
Identified Median Line	**Highest Probability and Shortest Time to Reach**			
	Dec to Feb	Mar to May	Jun to Aug	Sep to Nov
Faroe Islands	100 %	100 %	100 %	100 %
	0 days, 3 hrs	0 days, 3 hrs	0 days, 3 hrs	0 days, 3 hrs
Iceland	10 %	N/A	N/A	N/A
	29 days, 12 hrs	N/A	N/A	N/A
Norway	99 %	59 %	90 %	100 %
	6 days, 6 hrs	7 days, 15 hrs	9 days, 15 hrs	5 days, 15 hrs
Landfall				
Predicted Locations	**Highest Probability and Shortest Time to Reach**			
	Dec to Feb	Mar to May	Jun to Aug	Sep to Nov
The Faroe Islands	23 %	72 %	54 %	5 %
	8 days, 19 hrs	6 days, 11 hrs	8 days, 21 hrs	11 days, 15 hrs
Norway	64 %	2 %	8 %	49 %
	22 days, 5 hrs	35 days, 3 hrs	33 days, 10 hrs	17 days, 11 hrs
The Shetland Islands (UK)	89 %	63 %	56 %	56 %
	6 days, 23 hrs	7 days, 2 hrs	7 days, 6 hrs	5 days, 0 hrs
The Orkney Islands (UK)	1 %	10 %	19 %	N/A
	40 days, 6 hrs	14 days, 21 hrs	11 days, 9 hrs	N/A
Highland (UK)	N/A	10 %	8 %	N/A
	N/A	13 days, 14 hrs	27 days, 18 hrs	N/A
Eilean Siar (UK)	N/A	3 %	N/A	N/A
	N/A	19 days, 12 hrs	N/A	N/A
Shoreline Impact				
Mass of oil onshore	333 tonnes	2,494 tonnes	3,382 tonnes	386 tonnes
Volume of oil onshore	370 m^3	2,774 m^3	3,762 m^3	429 m^3
Water content	73 %	73 %	73 %	73 %
Volume of emulsion onshore	1,372 m^3	10,275 m^3	13,933 m^3	1,590 m^3
Key Sensitivities At Risk				
Discussed in Section 14.5.4				
Notes Source: OSRL, 2020a				

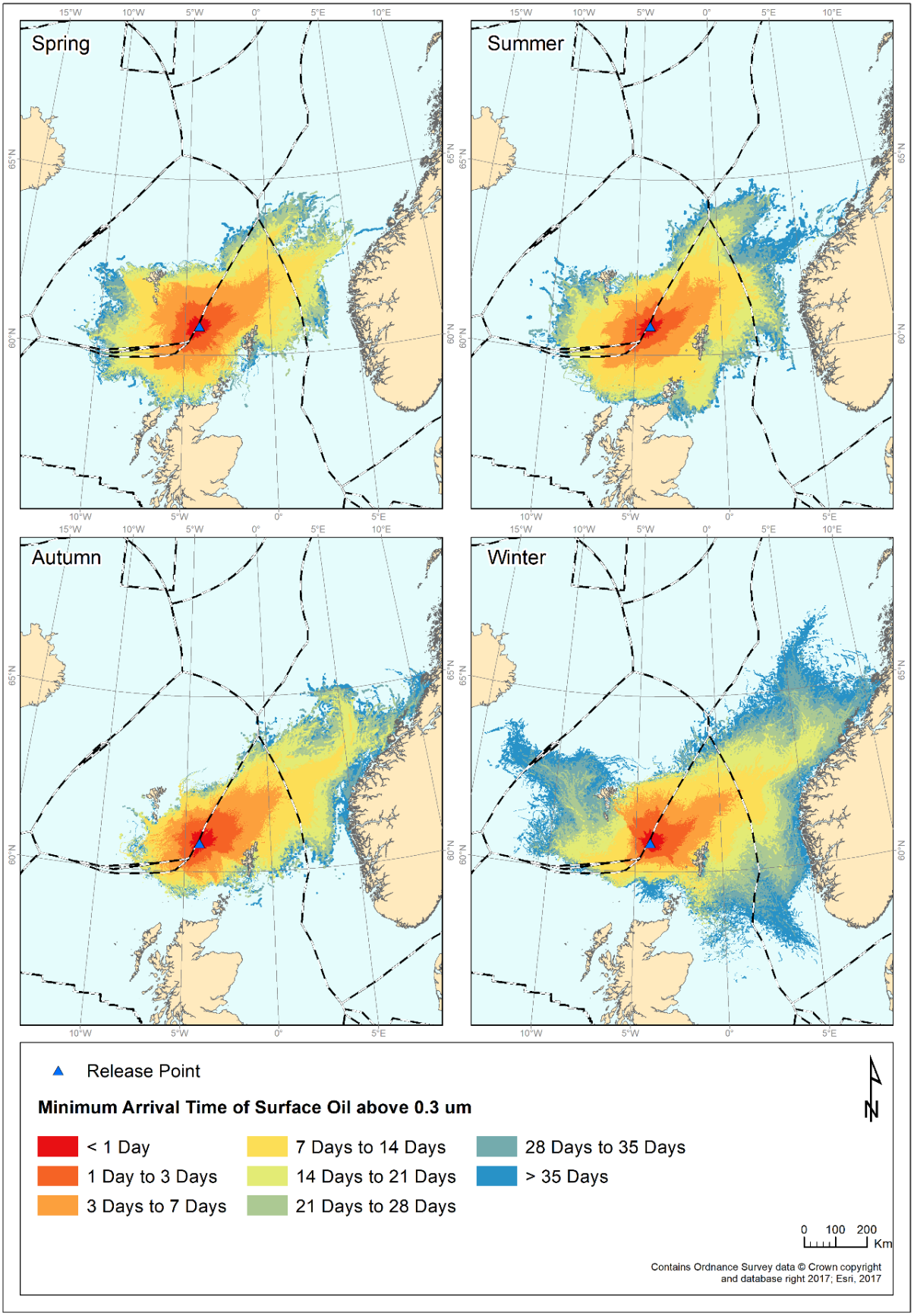


Figure 14.6: Well blow-out modelling: arrival time plot (OSRL, 2020a)

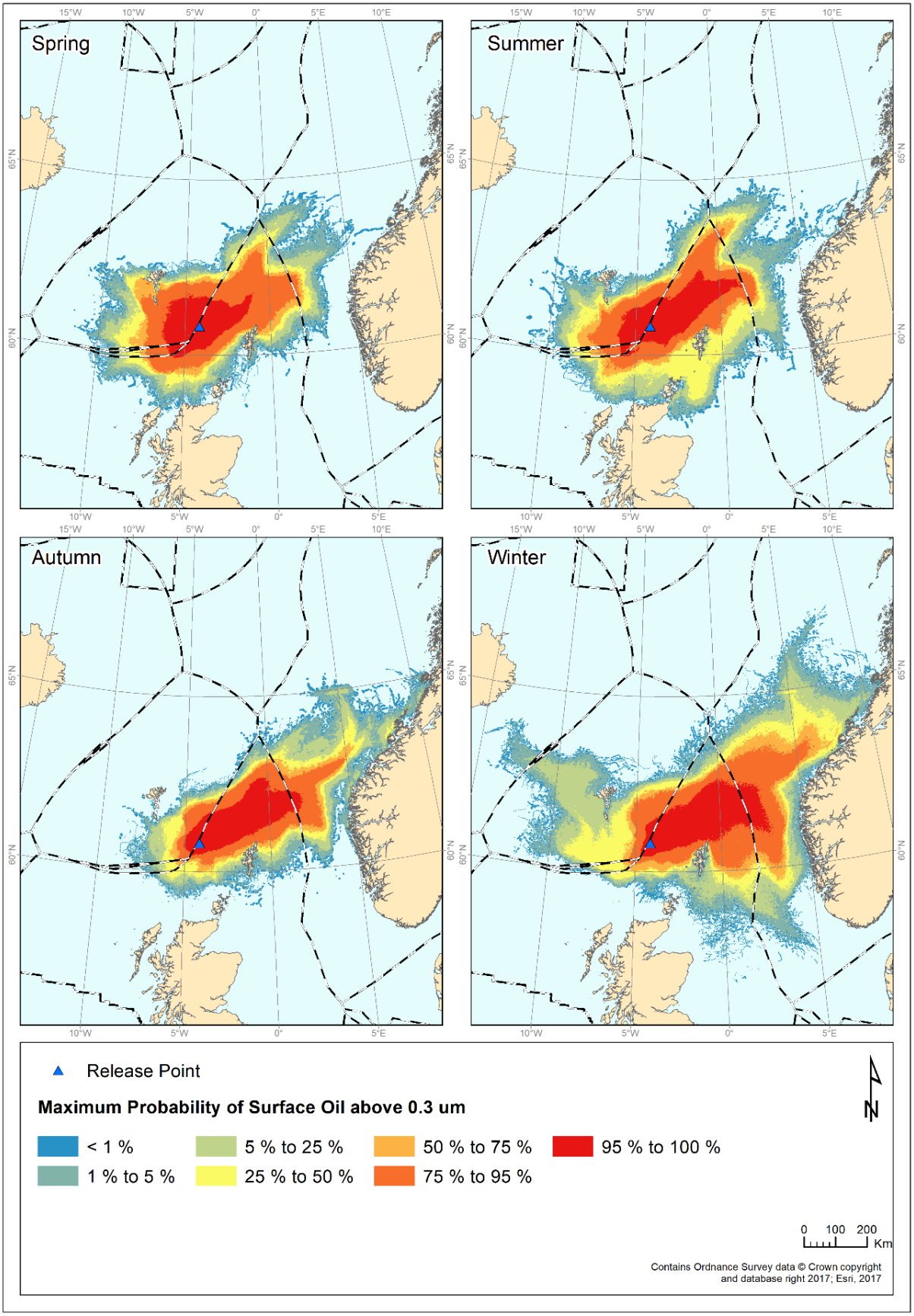


Figure 14.7: Well blow-out modelling: probability of surface oil (OSRL, 2020a)

14.4.3.2 Vertical Profile Modelling

In addition to the stochastic modelling detailed above, a vertical trajectory modelling run was undertaken, to provide a predication of the behaviour of crude oil in the water column in the event of a subsea blow-out release. The parameters used matched those used in the stochastic modelling, as detailed in Table 14.1.

The vertical profile shows the oil plume rising to the sea surface from the release depth of 1,082 m in approximately 2½ hours (Figure 14.8). The associated gas plume does not reach the sea surface, and is absorbed into the water column. As the small oil droplets encounter the thermocline at approximately 400 m below the sea surface, the speed of plume rising slows and some of the smaller droplets are halted. A sub-surface oil plume could potentially be trapped at this level, although the model does not show this outcome. Once the plume has risen to the surface, the plume model shows that it is likely to be driven by the water currents that generally flows towards the northeast (towards Norway) all year around (Section 5.3.1).

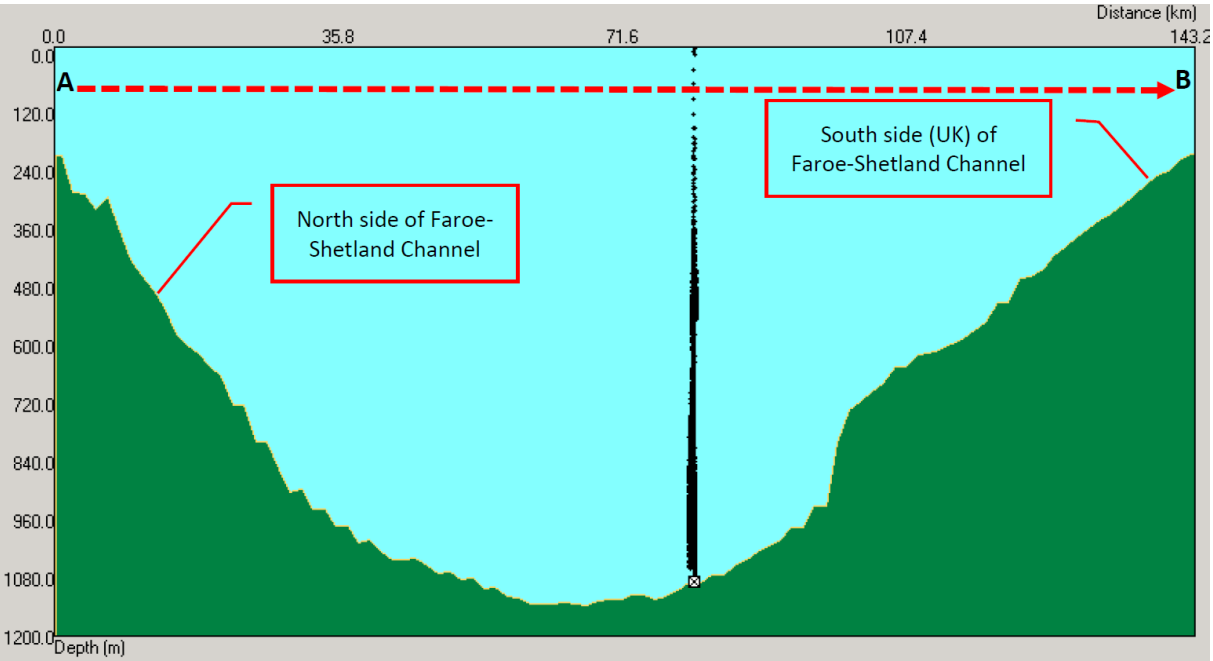


Figure 14.8: Vertical movement of Cambo crude oil plume (OSRL, 2018)

14.4.3.3 Complete Loss of FPSO Inventory

Guidance detailing oil spill modelling requirements states that the maximum possible inventory of crude oil onboard the FPSO (i.e. 103,342 m^3) should be modelled as an 'instantaneous release' (BEIS, 2022b). However, when attempting to model the maximum FPSO crude oil inventory as an instantaneous release (i.e. all oil is released in 1 second), this can result in unreliable modelling outputs in OSCAR. To avoid this, a more realistic worst-case maximum release rate of just over 1,000 m^3/hr has been applied, with the release duration extended appropriately. This scenario represents an instantaneous release as closely as possible, without compromising the reliability of the modelling results.

Table 14.3: Complete loss of FPSO inventory spill modelling parameters

Well Blow-out Parameters								
Loss from Well/FPSO/Rig/Other		FPSO		Instantaneous Loss?			No	
Worst Case [m^3]		103,342 m^3		Will the Well Self-Kill?			N/A	
Flow Rate [m^3/day]		1,003 m^3						
Justification for Predicted Worst Case Volume		Maximum FPSO storage inventory						
Location								
Spill Source Point		60° 48' 32.606" N, 004° 07' 15.914" W						
Installation / Facility Name		FPSO		Quad / Block			204/5	
Hydrocarbon Properties								
Hydrocarbon Name		Cambo						
Assay Available		No		Was An Analogue Used for Spill Modelling?			Yes	
	Name	ITOPF Category	Specific Gravity	API Gravity	Viscosity [cP]	Pour Point [°C]	Wax Content [%]	Asphaltene Content [%]
Hydrocarbon	Cambo crude	3	0.918	25.4	600	-36	8.4	0.35
Analogue	Schiehallion	3	0.899	25.9	180	3	7.0	0.36
Metocean Parameters								
Air Temperature (°C)		2°C to 15°C		Sea Temperature (°C)			7°C to 15°C	
Wind Data		2 years' (2012 to 2013) Oil & Gas UK* Data from the European Centre for Medium-Range Weather Forecasts (ECMWF) Wind Data						
Current Data		2 years' (2011 to 2013) Oil & Gas UK* Data: Shelf daily currents						
Modelled Release Parameters								
Surface or Subsurface		Surface		Depth [m]			0 m (Surface)	
Release Duration [days]		103 hours		Instantaneous?			No†	
Persistence Duration [days]		20 days		Release Rate [m^3/hour]			1,003 m^3/hours	
Total Simulation Time [days]		20 days		Total Release [m^3]			103,342 m^3	
Oil Spill Software								
Name of Software		MEMW-OSCAR		Version			11.0.1	

Notes
* - Now Offshore Energies UK
† - Although the guidance notes state that an instantaneous release rate should be modelled, in the case of such a large volume release, a longer release duration was used as it provides a more realistic approach and prevents possible errors within the model.
Source: OSRL, 2020b

The results of the FPSO inventory loss oil spill modelling scenario are provided in Table 14.4. Minimum arrival time of surface oiling is shown in Figure 14.9 and the probability of surface oiling in Figure 14.10. It should be noted that surface oiling is shown with a thickness threshold of 0.3 µm, in accordance with OPRED's oil spill modelling requirements.

Table 14.4: Complete loss of FPSO inventory spill modelling result

Complete Loss of FPSO Inventory Modelling Summary				
Spill Scenario/Descriptor	FPSO release			
Median Crossing				
Identified Median Line	**Highest Probability and Shortest Time to Reach**			
	Dec to Feb	Mar to May	Jun to Aug	Sep to Nov
Faroe Islands	85 %	94%	82 %	74 %
	0 days, 3 hrs	< 1 hr	0 days, 3 hrs	0 days, 3 hrs
Norway	76 %	34 %	62 %	86 %
	6 days, 9 hrs	9 days, 9 hrs	7 days, 12 hrs	6 days, 21 hrs
Landfall				
Predicted Locations	**Highest Probability and Shortest Time to Reach**			
	Dec to Feb	Mar to May	Jun to Aug	Sep to Nov
UK (The Shetland Islands)	49 %	29 %	50 %	41 %
	5 days, 3 hrs	5 days, 13 hrs	5 days, 2 hrs	5 days, 3 hrs
Norway	N/A	N/A	N/A	3 %
	N/A	N/A	N/A	17 days, 14 hrs
Faroe Islands	N/A	23 %	11 %	4 %
	N/A	7 days, 2 hrs	7 days, 24 hr	9 days, 8 hrs
Shoreline Impact				
Mass of oil onshore	466 tonnes	808 tonnes	5,061 tonnes	1,184 tonnes
Volume of oil onshore	518 m^3	899 m^3	5,630 m^3	1,317 m^3
Water content	73 %	73 %	73 %	73 %
Volume of emulsion onshore	1,920 m^3	3,329 m^3	20,850 m^3	4,878 m^3
Key Sensitivities At Risk				
Sensitivities/Sites of Concern	**Highest Probability and Shortest Time to Reach**			
Faroe-Shetland Sponge Belt MPA	100 %	91 %	100 %	100 %
	0 days, 6 hrs	0 days, 6 hrs	0 days, 9 hrs	0 days, 6 hrs
North-East Faroe-Shetland Channel MPA	96 %	67 %	95 %	97 %
	2 days, 21 hrs	3 days, 15 hrs	3 days, 6 hrs	2 days, 15 hrs
West Shetland Shelf MPA	5 %	25 %	15 %	4 %
	11 days, 9 hrs	4 days, 12 hrs	5 days, 12 hrs	5 days, 15 hrs
North West Orkney MPA	10 %	27 %	9 %	16 %
	6 days, 18 hrs	4 days,18 hrs	8 days, 21 hrs	6 days, 0 hrs
Pobie Bank Reef SAC	43 %	14 %	41 %	36 %
	7 days, 6 hrs	9 days, 15 hrs	7 days, 21 hrs	8 days, 6 hrs
	9 %	47 %	19 %	7 %

Complete Loss of FPSO Inventory Modelling Summary				
Wyville Thompson Ridge SAC	11 days, 6 hrs	2 days, 15 hrs	3 days, 18 hrs	10 days, 3 hrs
Darwin Mounds SAC	N/A	10 %	8 %	N/A
	N/A	7 days, 3 hrs	6 days, 15 hrs	N/A
Solan Bank Reef SAC	N/A	4 %	N/A	N/A
	N/A	13 days, 9 hrs	N/A	N/A
Seas off Foula SPA	5 %	4 %	5 %	9 %
	8 days, 12 hrs	12 days, 6 hrs	8 days, 0 hrs	5 days, 12 hrs
Hermaness, Saxa Vord and Valla Field SPA	44 %	25 %	49 %	41 %
	5 days, 3 hrs	5 days, 21 hrs	5 days, 3 hrs	6 days, 9 hrs
Fetlar SPA	22 %	16 %	25 %	20 %
	9 days, 3 hrs	8 days, 12 hrs	8 days, 0 hrs	9 days, 15 hrs
Fetlar to Haroldswick MPA	26 %	16 %	28 %	22 %
	9 days, 0 hrs	7 days, 15 hrs	8 days, 0 hrs	8 days, 18 hrs
Foula SPA	5 %	4 %	5 %	9 %
	8 days, 12 hrs	12 days, 6 hrs	8 days, 0 hrs	5 days, 12 hrs

Notes
MPA = Marine Protected Area
SAC = Special Area of Conservation
SPA = Special Protection Area
Source: OSRL, 2020b

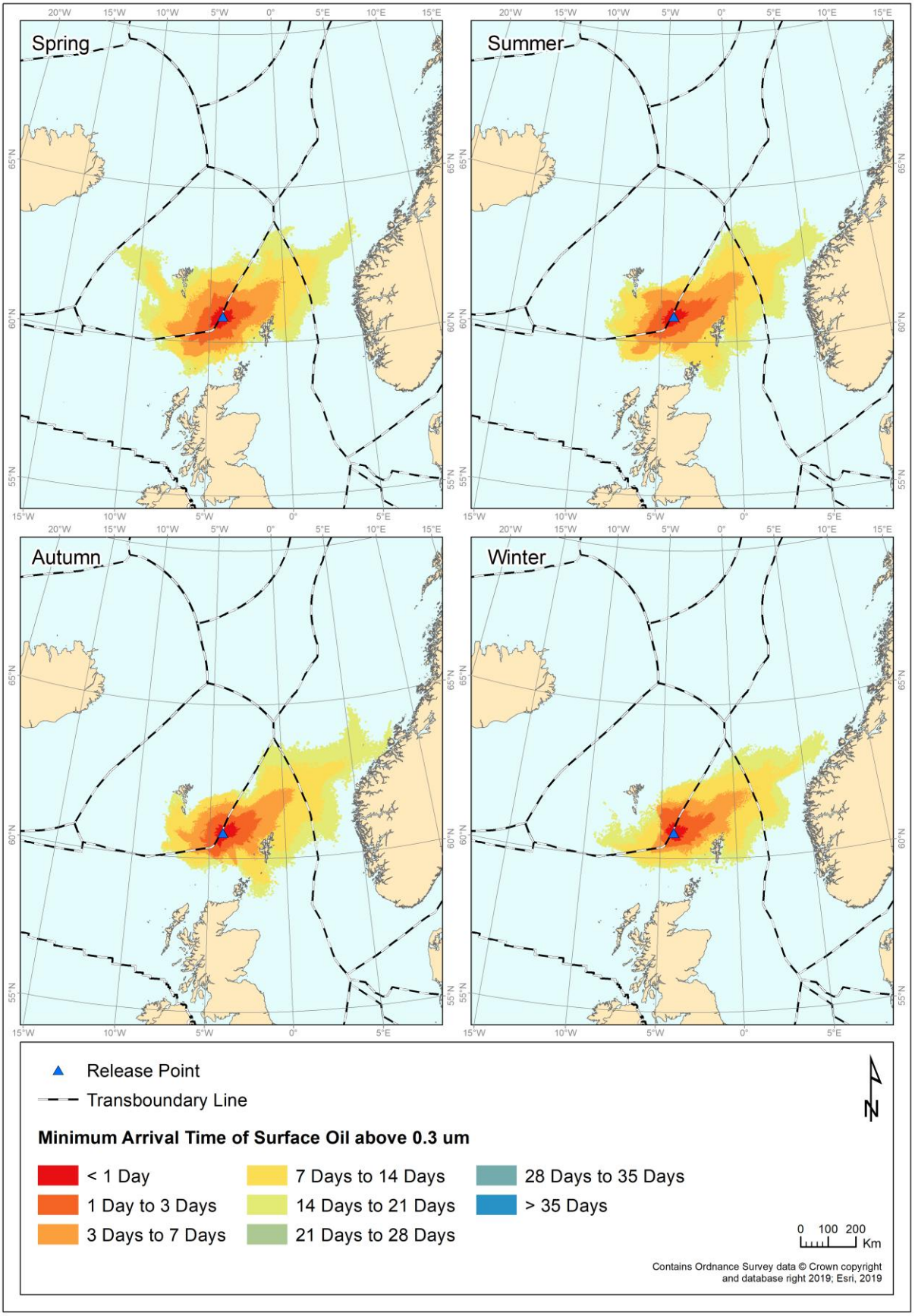


Figure 14.9: Complete loss of FPSO inventory spill modelling: arrival time plot (OSRL, 2020b)

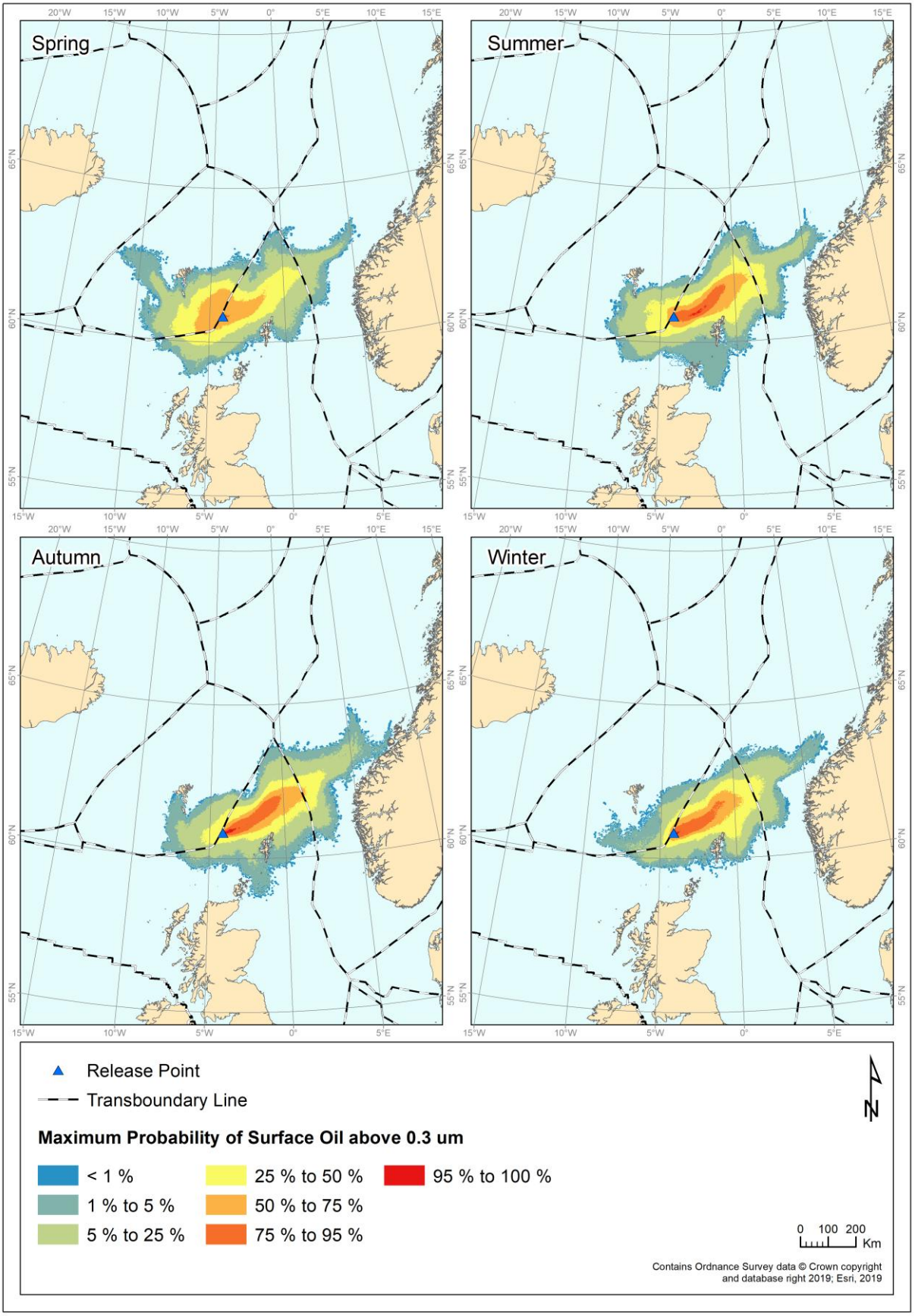


Figure 14.10: Complete loss of FPSO inventory spill modelling: probability of surface oil (OSRL, 2020b)

14.5 Potential Environmental Impacts

14.5.1 Impacts on Marine Life

The risk of accidental hydrocarbon spillage to the marine environment is one of the main environmental concerns associated with oil-industry activities. Although the effects of oil spills are well understood, the effects of each individual spill are unique and some assumptions have been made regarding predicting the effects of a large crude oil spill at the proposed Cambo field development.

14.5.1.1 Plankton

Oil, particularly diesel, is toxic to a wide range of planktonic organisms (Quigg et al., 2021; Siron et al., 1993). Oil slicks can inhibit light penetration which is essential for phytoplankton growth and photosynthesis whilst those living near the sea surface are particularly at risk, as water-soluble components leach from floating oil (Quigg et al., 2021). However, the extent of any effect is largely dependent on the structure of their communities. Some studies have shown that phytoplankton growth responses vary in response to exposure to contaminants such as crude oil, with some finding growth increases and others finding growth decreases (Quigg et al., 2021; Tang et al., 2019; Varela et al., 2006). Evidence of toxicity of both crude oil and dispersants within phytoplankton has been reported in plankton communities in the Gulf of Mexico (Ozhan & Bargu, 2014) following the Deepwater Horizon spill (Buskey et al., 2016). Zooplankton at the surface are considered to be particularly sensitive to oil spills due to their proximity to high concentrations of dissolved hydrocarbon and to the additional toxicity of photo-degraded hydrocarbon products at this boundary (Bellas et al., 2013). The direct ingestion of dispersed oil droplets has also been reported on zooplankton species (Lee et al., 2012).

Although oil spills may kill individuals, the effects on whole plankton communities generally appear to be short-term. Following an oil spill incident, plankton biomass may fall dramatically, due either to species mortality or avoidance of the area leading to community shifts (Severin & Erdner, 2019). Taxon specific responses are complex and will ultimately vary according to the specific plankton species and depend on factors such as oil type and concentration as well as environmental influences (Severin & Erdner, 2019). However, after only a few weeks, some populations may be expected to return to previous levels through a combination of high reproductive rates and immigration from outside the affected area (NSTF, 1993).

The magnitude of effect of an oil spill (either due to a well blow-out or diesel release) on plankton species, a receptor of '**Low**' value due to the large and widespread abundance of plankton, is considered to be '**Major**' and therefore overall effect significance is '**Moderate adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be **'Not Significant'**.

14.5.1.2 Benthos - Shallow Coastal Communities

It is generally assumed those animals associated with the seabed will remain unaffected by a surface slick as the floating oil moves above them. However, a fraction of the water-soluble components of a slick may dissolve into the water column, assisted by rough seas or agitation of the sea surface, where these could potentially be harmful to benthic organisms. If the spilled oil drifts inshore, the benthic communities of the shallow coastal areas may be affected.

The benthic species response to hydrocarbon exposure varies depending on life history, feeding behaviour and the ability to metabolise toxins. Community-level changes in the biomass, density, and diversity of protistan, meio-/macro-/mega- faunal assemblages have been recorded in numerous studies (Currie & Isaacs, 2005; Gray et al., 1990; Jones et al., 2007; Lanzen et al., 2016; Netto et al., 2009; Santos et al., 2009). Parameters such as local bathymetry and sediments types would significantly influence the distribution of oil contamination at the seabed.

It should be noted that any oil that reaches some these shallow areas will have travelled a considerable distance through the water column and across the sea surface, and will therefore have been affected by the range of degradation processes described in Section 14.4 including evaporation, dissolution and biodegradation (Keramea et al., 2021). These mechanisms will have contributed to decreases in the toxicity of the oil (ITOPF, 2014a; USEPA, 1999) and the primary effect of the oil deposition on benthic communities is likely to be smothering (ITOPF, 2014b). As the oil will also have become widely dispersed by this point, the physical effects of smothering are expected to be limited.

The shoreline itself is particularly susceptible to oil beaching. The potential impacts arising from beached oil in coastal habitats are discussed separately in Section 14.5.2.

If an oil spill was to occur and oil settles on the seabed and / or coastal areas, it is considered that the magnitude of effect would be '**Major'** on receptors of '**Very High**' value (e.g. coastal lagoons, reefs, submerged or partially submerged sea caves, mudflats and sandbanks which are designated features for Special Areas of Conservation (SACs)) and therefore overall effect significance is '**Major adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be **'Not Significant'**.

14.5.1.3 Benthos Deepwater Communities

As described above (Section 14.4.3.2), the buoyancy of the produced oil (and associated gas) will carry all hydrocarbons straight up to the sea surface in the event of a subsea spill. In offshore areas such as the Cambo field, impacts on the benthos from a release of oil are likely to be very minimal, due to the water depth (between 1,073 m and 1,105 m). Therefore, it is expected to be unlikely for the crude oil to reach the surrounding benthic communities.

It is unknown how exactly a subsea oil spill would affect the benthos. Assessing the effects of toxic contamination on biotopes is extremely difficult because varying quantities of different

contaminants can have very different effects on marine organisms. However, reported effects from large oil spills, such as the Ekofisk blow-out in 1977 and the Braer oil spill in 1993, were limited to some chemical contamination of seabed sediments at the latter, with neither spill appearing to have resulted in any acute biological effects (Kingston et al., 1995).

The habitats and associated benthic communities of the Faroe-Shetland Channel vary in relation to water depth, with a series of broad zones recorded (Section 5.3). Beyond the continental slope, few distinct features are supported and sediments become finer with increasing depth. As sediments become finer, the characteristic benthic species present change from largely suspension feeding to deposit feeding types.

Suspension feeders gather their food directly from the seawater and would, therefore, take in any oil present within the surrounding water leaving them more vulnerable to the toxic effects of oil dispersed in the water column. Deposit feeders are supported by the fine organic matter trapped between the fine sediments and these animals would only be affected if the dispersed oil settled on the seabed.

Any subsea release of crude oil would be pushed directly up in a plume to the sea surface, rather than towards the surrounding benthic communities. It would then be carried away from the spill location by the local current systems, with the majority of the oil moving to the northeast (Figure 14.7). Due to the time it would take to reach these areas and the large surface area available for microbial attack, it is expected that most of the toxic constituents would have been lost from the plume. It therefore seems unlikely that the released oil would significantly affect either suspension feeding or the more prevalent deposit feeding species comprising deep-water benthic communities.

No seabed features of conservation value have been recorded in the immediate area surrounding the proposed Cambo field development. The nearest area of conservation importance is Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Areas (NCMPA), which lies 16 km southeast of the Cambo field. As stated above, it is expected that all spilled oil would be transported to the sea surface, and therefore the protected features of the Faroe-Shetland Sponge Belt NCMPA would not be impacted in the event of a seabed spill.

Consequently, if an oil spill was to occur and oil settles on the seabed it is considered that the magnitude of effect would be **'Major'** on receptors of **'Medium'** value and therefore overall effect significance is **'Moderate adverse'**. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be '**Not Significant**'.

14.5.1.4 Fish

Offshore fish populations remain relatively unaffected by oil pollution, as oil concentrations below the surface slick are generally low (Claireaux et al., 2018; Clark, 2001; NOAA, 2021). There is also evidence that fish are able to detect and avoid oil-contaminated waters (IPIECA, 2000). This avoidance may, however, cause disruption to migration or spawning patterns.

Comparatively little is known about the distribution and abundance of deepwater fish species in the Faroe-Shetland Channel. Many of these species have slow growth rates, late onset of sexual maturity and low fecundity, leaving them vulnerable to the effects of disturbance.

Rather than impacting the fish directly, heavily contaminated sediments may have the potential to affect local populations of demersal fish species, due to the impact it has lower down the food chain on potential prey organisms such as phytoplankton for example. However, as described in the sections above (see Section 14.5.1.1 to 14.5.1.3), heavy contamination of the sediments is not expected.

Few studies have demonstrated increased mortality in fish species as a result of oil spills (Langangen et al., 2017). Fish eggs and larvae are more vulnerable to oil pollution than adult fish. In many fish species, these stages float to the surface where contact with spilt oil is more likely. Therefore, fish stocks may be vulnerable to spills that occur close to spawning or nursery grounds as fish eggs and larvae are susceptible to toxic oil compounds which can kill or cause sub lethal effects (Carpenter, 2019; Langangen et al., 2017).

A number of commercial species have spawning grounds in the Faroe-Shetland region. No spawning grounds were identified within the Cambo field development although spawning grounds for blue whiting are thought to be present to the west (see Section 5.4.3, Figure 5.14). However, as the majority of these species have extensive spawning grounds and produce large numbers of pelagic young, there is unlikely to be any long-lasting effect on numbers in the adult populations. Certain fish stocks may be more affected than others, particularly if the spill is very large, coincides with spawning periods, or enters the grounds of species with restricted spawning areas.

The magnitude of effect of an oil spill on fish species is considered to be '**Major**' on receptors of '**High**' to '**Very High**' value, due to the presence of spawning grounds of designated Priority Marine Features (PMF) and Oslo and Paris Convention (OSPAR) listed species in the area, and therefore overall effect significance is '**Major adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be '**Not Significant**'.

14.5.1.5 Shellfish

If oil reaches the seabed, shellfish species that cannot move away from oiled sediments are susceptible to its effects. Mortalities may occur if shellfish become smothered by settling oil. Only low levels of oil in seawater may cause tainting in shellfish, which may be commercially damaging to shellfish fisheries. This is more common in filter feeding shellfish, principally bivalves, as they would take up fine oil droplets from the water column.

In the deepwater of the Faroe-Shetland Channel, commercially important shellfish are only found in very small quantities and shellfish landings are low across the field development area (Marine Directorate, 2025c). Moreover, as explained above, it is extremely unlikely that any hydrocarbons released from a subsea blow-out would remain near the seabed. The inshore waters around Shetland do, however, support commercially important shellfish fisheries, which may be at risk if a spill reaches these waters. This is considered in Section 14.5.3.2.

Therefore, the magnitude of effect of an oil spill on shellfish species is considered to be '**Major**' on a receptor of '**High**' value, due to their conservation status (PMF), and therefore overall effect significance is '**Major adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3 as well as the direction of the oil plume (in the event of a well blow out) as considered in Section 14.4.3.2. Therefore, final effect significance is judged to be **'Not Significant'**.

14.5.1.6 Marine Mammals

Several cetacean species are known to occur in the vicinity of the Cambo field development (see Section 5.4.4.1). The species present throughout the year and most commonly encountered include killer whale, long-finned pilot whale, sperm whale, and Atlantic white-sided dolphin. Other species in the wider area include fin whale, minke whale, Risso's dolphin and Sei whale.

Whales, dolphins and porpoises are not considered to be affected by an oil spill in similar ways as birds, fish and otters. Oil is unlikely to adhere to their skin, due to its slickness and is not expected to accumulate in or around the eyes, mouth, blow hole or other potentially sensitive areas (Helm et al., 2015). Furthermore, these marine species do not consume large quantities of seawater, do not groom themselves and are unlikely to consume oil-contaminated prey, therefore they are unlikely to ingest significant quantities of oil (Helm et al., 2015).

The greatest risk to most cetaceans from an oil spill is likely to occur if they come into contact with an oil spill when they surface to breathe and inhale oil and/or toxic petroleum vapours (de Lima et al., 2023). This may impact on the individuals' respiratory system (Frasier et al., 2019; Helm et al., 2015; Schwacke et al., 2013), as when concentrated vapours are inhaled, mucous membranes may become inflamed, lungs can become congested, and pneumonia may ensue. Inhaled fumes from oil may accumulate in blood and other tissues, leading to possible liver damage, reproductive impairment and neurological disorders (Helm et al., 2015). Ingestion of

oil contaminated prey or foraging in areas affected by an oil spill is one direct way in which cetaceans will come into contact with oil components. Some cetaceans, particularly odontocetes (toothed whales), employ suction feeding to capture prey which may also see an animal ingest oil in the water column (de Lima et al., 2023) whilst mysticetes (baleen whales), which feed using baleen plates in their mouths, may clog these plates when taking in oil contaminated water (de Lima et al., 2023).

Previous studies have shown that some species of cetacean may be able to detect and avoid oil spills, but this was dependent on oil thickness and colour (Aichinger Dias et al., 2017). The mechanisms used to avoid oil spills have not been confirmed however it is believed that echolocation or taste may play a role (de Lima et al., 2023). Studies undertaken after the Deep-Water Horizon spill in the Gulf of Mexico noted that cetaceans present in the area that came into direct contact with oil did not show any avoidance of a slick (Aichinger Dias et al., 2017).

A thick layer of blubber protects cetaceans and adult seals from the cold and these animals are less vulnerable to the physical impacts of oil lowering their resistance to the cold (Helm et al., 2015). Seal pups and otters are at risk from hypothermia if their fur becomes oiled and loses its thermal properties, as they do not have sufficient blubber underneath their fur to keep them warm (Helm et al., 2015). When seals are exposed to oil at sea they may ingest it, leading to the oil being absorbed into the blood and transferring to muscles, liver and fat (de Lima et al., 2023). Contact of oils with the skin may also lead to prolonged coating of the body which can hamper the animal's ability to swim (de Lima et al., 2023).

Both grey and common seals are known to breed on the Shetland and Orkney Islands (see Section 5.4.4.2). The Shetland and Orkney Islands also support important otter populations. These marine mammals may be at risk if a slick reaches coastal areas.

The magnitude of effect of an oil spill on marine mammals, it is considered to be '**Major**' on a receptor of '**Very High**' value, due to their internationally and nationally protected status (Section 5.4.4.1) and therefore overall effect significance is '**Major adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be **'Not Significant'**.

14.5.1.7 Seabirds

Seabirds are particularly vulnerable to oil pollution at the sea surface (Munilla et al., 2011; Votier et al., 2005), especially during large oil spills. The effects of oil pollution on diving seabirds such as seaducks (Anatidae), divers (Gaviidae), cormorants (Phalacracoracidae), grebes (Podicepididae) and auks (Alcidae) are likely to be more pronounced than aerial species such as gulls (Laridae) (Webb et al., 2016).

After exposure to oil, birds may experience negative effects on their reproductive success as well as their cardiovascular and respiratory systems, cellular damage and heightened metabolic cost through increased foraging time (Michael et al., 2022; Takeshita et al., 2021; Troisi et al.,

2016). Ingested oil may also result in pathological changes in the intestinal tract, lungs, liver and kidneys leading to a range of negative impacts on survivability (Alonso-Alvarez et al., 2007; Troisi et al., 2016). Exposure to oil may also affect long-term reproductive success (Michael et al., 2022).

Even thin sheens of oil may adhere to feathers comprising their structure and potentially affecting thermoregulation (Michael et al., 2022). Seabirds that survive with oil contaminated feathers may be able to remove traces of oil by preening. There is little information on the extent and speed with which full functionality is restored, however, some wild gulls and terns have been shown to remove visible oil within 10 weeks (King et al., 2021).

Despite considerable effort to rescue, clean and reintroduce seabirds which have been impacted by an oil spill, post release survival is low with successful rehabilitation requiring high quality facilities and veterinary skills (Heubeck et al., 2003; Troisi et al., 2016).

The aerial habits of the fulmar and gulls, together with their large populations and widespread distribution, reduce vulnerability of these species. Gannets, skuas and auk species are considered to be most vulnerable to oil pollution due to a combination of heavy reliance on the marine environment, low breeding output with a long period of immaturity before breeding, and the regional presence of a large percentage of the biogeographical population (DTI, 2003).

The sensitivity of bird species to oil pollution is classified between 'low' and 'medium' for UKCS Blocks 204/4, 204/5, 204/9, 204/10, 205/1, and 205/2 throughout the year, with a peak in sensitivity reported in September (Webb et al., 2016; see Section 5.4.5). The majority of surrounding UKCS Blocks are also classified between 'low' and 'medium' sensitivity, increasing to 'high' in early spring and 'extremely high' in autumn (Webb et al., 2016).

The magnitude of effect of an oil spill on seabirds given the wide area that would be impacted by a release of hydrocarbons, is considered to be '**Major**' on a receptor of '**Very High**' value, due to their internationally and nationally protected status (e.g. black legged kittiwake is OSPAR listed), and therefore overall effect significance is '**Major adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be '**Not Significant**'.

14.5.2 Impacts on Coastal and Inshore Habitats

The coastlines of the Shetland, Orkney and Faroe Islands support a range of different habitat types. These coastlines are important for nature conservation, with numerous sites along the coastline designated under national and international legislation (see Section 5.6). In the unlikely event of a large spill, these coastlines are potentially at risk. Although the probability of a spill reaching shore, and the amount of crude oil that would do so, is very low.

The modelling predicts that, for both scenarios, the shorelines of the UK, Norway and the Faroe Islands have the potential to receive oil on their shores in the event of a spill from either a well

blowout or FPSO release (Table 14.2 and Table 14.4). The probability of shoreline oiling is less than 25 % for the majority of countries and seasons for each scenario modelled however higher probabilities are predicted for the Faroe Islands in spring (72 %) and summer (54 %), Norway in winter (64 %) and the Shetland Islands in all four seasons (minimum 56 % probability) (Table 14.2). The shortest time for a spill to reach a shoreline was predicted to occur in autumn affecting the Shetland Islands (5 days, 0 hours) in the well blow-out scenario (Table 14.2).

14.5.2.1 Rocky Shores

Rocky shores can be very varied in structure, ranging from exposed vertical walls to flat bedrock, or stable boulder fields to aggregations of cobbles. These shores may support a variety of sessile animal and plant communities which live attached to the rock surface, as well as a range of associated mobile invertebrates and fish. More exposed rocky shores are typically dominated by sessile animals and smaller, more robust seaweeds, while the more sheltered shores are characterised by the large brown kelps.

Rocky shores are high energy environments and, while oil may have an impact on the animals and plants which live on them, stranded oil is often quickly removed by wave action and water movement. The vulnerability of rocky shore habitats to oiling is dependent on the type of rocky shore and its exposure. The action of the waves may start to remove the oil from an exposed vertical wall almost immediately, but the oil may remain for longer in more sheltered, kelp dominated areas.

Many of the animals and small seaweeds found on rocky shores would be killed by exposure to fresh and light oils, but much of the crude oil potentially reaching the shore from a large spill at the Cambo field development location would have been at sea for several days (a minimum of 5 days) and would have lost most of its toxic constituents through the oil weathering process (Keramea et al., 2021). Various shoreline species have been observed to survive shoreline oiling and continue feeding in oiled areas, suggesting that the toxic impacts would be minimal (Clark, 2001). However, even if the beached oil is relatively non-toxic, heavily weathered oil may still cause damage due to its physical properties. Large amounts of stranded oil may impact upon shoreline animals by smothering them. Those animal species that are large enough to protrude above the oil or can move away quickly may survive, but smaller species would be killed by inhibition of their feeding and respiration mechanisms. Many of the larger brown seaweeds which dominate the more sheltered rocky shores secrete mucus which would prevent oil adhering to them (IPIECA, 2016). However, if oil does adhere to the seaweed fronds, instead of killing the seaweeds directly, the oil will increase their overall weight potentially resulting in them being pulled from the rocks by the wave action.

The rate of recovery and the form it takes will depend upon the type of rocky shore and the animals and plants that live on it. The general experience of oil spills on rocky shores is that substantial recovery can be achieved within two to four years (Park et al., 2022), but biological factors may intervene and cause a prolonged change. Rocky shores are high energy, highly productive environments, where the physical and biological factors exerted upon them lead to

intense competition between the species which live there. The physical factors, such as desiccation, extremes of temperature, and changes in salinity, can cause mortalities in rocky shore communities, while the severe winter storms can pull many animals and plants from the shore each year (Little & Kitching, 1996). As a result, these communities, particularly those on the coastlines surrounding the highly dynamic West of Shetland area, have the capability to regenerate quickly in order to take advantage of the newly available space.

Oil spill modelling indicates that, under the majority of meteorological circumstances, a large oil slick will drift northeast of the Cambo field development, leaving the coasts of Shetland and Norway under the greatest threat of shoreline oiling (OSRL, 2018a; 2018b; Section 14.4.3). The coastlines of the Orkney and Faroe Islands may also be affected. During spring and summer time, the northern coasts of the Isle of Lewis and the Scottish mainland may also be at risk. These shores are all dominated by steep sea cliffs and high energy rocky shores (see Section 5.5). It could therefore be assumed that these northerly rocky shores could recover relatively quickly from a beaching oil spill.

14.5.2.2 Sedimentary Shores

The fate of oil stranded on sediment shores depends on the nature of the substratum (IPIECA, 2008, 2016). Due to the increased sediment movement and relatively large gaps between the particles, beached heavy oil can penetrate further into the more mobile shingle or coarse sand shores. These coarse sediment shores tend to be less productive than sheltered mudflats, where waterlogged sediments, rich in organic matter, can accommodate huge numbers of invertebrates. Gaps between the shingle or sand grains allow the water to drain away quickly between the tides and the movement of the sediment itself is very abrasive, meaning few animals can survive in it. If the beaching of an oil spill becomes inevitable, sandy beaches have in the past been considered as sacrificial areas. A spill may be directed towards a sandy beach to protect other, more sensitive, shorelines. Soft sediment areas are rare on the Shetland Islands, with sandy beaches making up very small proportion of the total coastline (see Section 5.5.1).

In contrast, oil does not readily penetrate the sediments in areas of firm waterlogged mud or fine sand and tends to be carried away with the next tide (Clark, 2001). However, there is a concern over oil beaching on sheltered mudflats or associated sensitive areas of saltmarsh and these are often priority areas for protection following oil spills. These are generally highly productive areas, with high numbers of invertebrates living within the sediments which may provide a valuable food source for juvenile fish and birds (Little, 2000). Recovery times tend to be longer in these sheltered areas, due to the reduced bacterial degradation and persistence of the oil, particularly if it penetrates into the sediment (IPIECA, 2008). The process of cleaning the sediments and vegetation can be very difficult in these areas and could potentially exacerbate any damage to the habitat. In the most sheltered of intertidal areas, where very fine sediments accumulate, saltmarshes may be found. Small patches of saltmarsh are found at the heads of voes and in other very sheltered areas on the Shetland Islands, but these make up only 0.2 % of the available coastline (Section 5.5.1).

The magnitude of effect of an oil spill on coastal and inshore habitats given the wide area (Figure 14.7) that would be impacted by a well blow-out as a worst case scenario, is considered to be '**Major**' on a receptor of '**Very High**' value due to numerous sites designated under national and international legislation, and therefore overall effect significance is '**Major adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be '**Not Significant**'.

14.5.3 Impacts on Other Users of the Sea

14.5.3.1 Commercial Fisheries

Fishing activity in the area immediately around the proposed Cambo field development is very low when compared with the shallower slope and shelf waters (Marine Directorate, 2025c; Section 5.7.1). The mixed demersal fisheries take the greatest proportion of fish landed from the continental shelf and shelf break, to the east of the Cambo field. These trawl fisheries operate year-round and nets could potentially become tainted in the unlikely event of a large oil spill occurring. Pelagic fisheries, predominantly targeting mackerel and herring, usually operate in more inshore locations around the Shetland and Orkney Islands. Shellfish landings within the area of the Cambo field development are considered to be very low compared to activity registered.

The effects of oil spills on commercial fish and shellfish, and the indirect impacts on their habitats, are described above (Section 14.5). Fish and shellfish exposed to oil may become tainted which could prevent an entire catch from being sold (Clark, 2001). There is evidence that fish are able to detect and avoid oil-contaminated waters (IPIECA, 2000), therefore tainting is more a concern for immobile shellfish which cannot swim away. This is more common in filter feeding shellfish, such as scallops, as they could take up fine oil droplets from the water column.

Very small quantities of squid and crab are the only shellfish taken from the area around the proposed Cambo field development. Crabs are typically exposed to oil toxicity through coating on the body and feeding on polluted sediments which affects physiology and behaviour (Yuewen & Adzigbil, 2018). After the Sea Empress oil spill, landings of crabs and other important crustaceans declined due to closure orders restricting fishing however landings returned to pre spill levels the following year potentially due to the closure orders facilitating growth (Edwards & White, 1999).

If fishing in the area of an oil spill, nets may become fouled with floating oil. This not only causes damage to the nets themselves but contact with fouled fishing gear may also contaminate subsequent catches. Major spills may also result in loss of fishing opportunities with boats unable or unwilling to fish due to the risk of fouling causing a temporary financial loss to commercial fishermen.

The magnitude of effect of an oil spill on commercial fisheries, due to the importance of the area for fishing, is considered to be '**Major**' on a receptor of '**Medium**' value due to areas used by local fisheries but with nearby alternatives, and therefore overall effect significance is '**Moderate adverse**'. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be **'Not Significant'**.

14.5.3.2 Aquaculture

Numerous fish and shellfish farms are distributed across the Shetland and Faroe Islands (Section 5.7.2) and, therefore, aquaculture is an important contributor to the economies of these island groups. Most of Shetland's shellfish farms are situated on the moderately exposed west coast of the mainland, the majority of which produce mussels (Scottish Government, 2025), whilst fish farms for finfish cultivation are also present around the coastlines of Shetland and Orkney producing species such as salmon, cod and halibut (Section 5.7.2).

Tainting is of concern for all caged fish and shellfish farms as the animals are unable to swim away. If a large surface spill is allowed to reach these islands the many mariculture farms which cultivate fish and shellfish may be at risk from tainting and fouling, potentially leaving their stock unmarketable and their sites liable to closure (Andrews et al., 2021).

Although all oils can cause taint, lighter oils are generally more potent (Clark, 2001). Any large oil spill from the proposed Cambo field development would have undergone the weathering processes described above (Section 14.4.2) and, therefore, will have lost many of its lighter fractions by the time it reached the shore (ITOPF, 2014a; Keramea et al., 2022; USEPA, 1999). Although this would not completely prevent the environmental impact of the oil with regard to tainting, it may limit the severity.

Oil spill modelling in the case of an uncontrolled well blow-out predicts that the oil has an 89 % probability of reaching the coastline of the Shetland Islands (Table 14.2) potentially impacting on aquaculture sites located in the area. The oil is predicted to take approximately 6 days and 23 hours to arrive (OSRL, 2020a).

Therefore, the magnitude of effect of an oil spill (well blow-out) on aquaculture sites, is considered to be '**Major**' on a receptor of '**High**' value, and therefore overall effect significance is '**Major adverse'**. The likelihood of this occurring however is considered to be '**Remote**' due to the perceived frequency of such an incident occurring as discussed in Sections 14.2 and 14.3. Therefore, final effect significance is judged to be **'Not Significant'**.

14.5.4 In-combination, Cumulative and Transboundary Effects

If a spill was to occur, any released oil may have the potential to act 'in-combination' with other aspects of the Cambo field development and impact on some receptors leading to a combined effect. However, with respect to an accidental release of hydrocarbons, no potentially significant in-combination effects were identified which would justify further assessment,

beyond the individual effects that have already been considered in this section, as this would not alter the conclusions reached.

In terms of cumulative impacts, there is considered to be limited potential for an accidental release of hydrocarbons from the Cambo field development or any other existing installation to occur (Section 14.2 and 14.3). Therefore, no significant cumulative impacts are considered likely. In the event of an accidental release of hydrocarbons the responses measures detailed in the Oil Pollution Emergency Plan (OPEP) and / or Temporary Operations Oil Pollution Emergency Plan (TOOPEP) for the respective installation would be implemented.

The greatest potential for transboundary impacts is considered to arise from an uncontrolled well blow out and the complete loss of FPSO inventory as this would see a large volume of hydrocarbons released to the marine environment. Modelling of this release of hydrocarbons predicts that the oil may reach the median lines of the Faroe Islands, Norway and Iceland (Table 14.2 and Table 14.4) with varying degrees of probability as discussed in Section 14.4.3. If a spill were to occur, then the mitigation measures set out in Section 14.7 would be implemented, in consultation with the relevant authorities, to minimise potential impacts to the marine environment.

14.6 Potential for a Major Environmental Incident

The Offshore Safety Directive (2013/30/EU) came into force, via UK Regulations, on 19 July 2015. These Regulations require that a Safety Case defining Major Accident Hazards (MAH) with the potential to cause Major Accidents (MA) must be in place to cover all relevant offshore operations. The potential for MAs to cause a Major Environmental Incident (MEI) must also be defined in the Safety Case. For the Cambo field development, two scenarios with the potential to cause a MEI have been identified (Section 14.1):

- Spillage of hydrocarbons in the event of an uncontrolled well blow-out; and
- Rupture of crude oil storage tanks.

Therefore, these two scenarios have been used as the basis for the MEI Assessment.

14.6.1 MEI Assessment Methodology

The Offshore Safety Directive defines a MEI as an incident which results, or is likely to result, in significant adverse effects on the environment (Article 2[37]). Environmental vulnerability to oil spills is dependent on both the size of the spill and also the sensitivity of receptors. There is no standard quantitative method of determining the environmental impact likely to be associated with an oil spill, and so a qualitative approach based on the "Impact Scales and Gradation of Oil Spill Ecological Hazards and Consequences in the Marine Environments" classification guide by Patin (2004) has been used for this MEI assessment.

Table 14.5 shows the consequence assessment methodology defined by Patin (2004). These criteria have been used to consider the potential impact of a worst-case scenario oil spill from the Cambo field development on UK protected sites, including Special Protection Areas (SPA),

SAC and NCMPA, which have been designated for the protection of habitats and species. Whilst the MEI Assessment is solely required to consider the impact to UK sites, it is acknowledged that the oil spill modelling results show potential for oil reaching the waters of the Faroe Islands, Iceland and Norway, and potential for oil beaching in Norway or the Faroe Islands. In the event of an incident that could impact the waters of an adjacent State, Ithaca Energy would liaise with the relevant national authorities to assess the scale of any potential impacts.

Table 14.5: Consequence assessment methodology based on Patin (2004)

A. Spatial Scale (Area)	
Spatial Scale	Area Under Impact
Point	Less than 100 m^2
Local	Range from 100 m^2 to 1 km^2
Confined	Range from 1 km^2 to 100 km^2
Sub-regional	More than 100 km^2
Regional	Spread over shelf area

B. Temporal Scale	
Temporal Scale	Longevity
Short term	Several minutes to several days
Temporary	Several days to one season
Long term	One season to 1 year
Chronic	More than 1 year

C. Reversibility of Change	
Reversibility of Change	Longevity of Disturbance
Reversible (acute stress)	Acute disturbances in the state of environment and stresses in biota that can be eliminated either naturally or artificially within a short time span (several days to one season)
Slightly reversible	Disturbances in the state of environment and stresses in biota that can be eliminated either naturally or artificially within a relatively short time span (one season to 3 years)
Irreversible (chronic stress)	Prolonged disturbances in the state of environment and stresses in biota that exist longer than 3 years

D. Consequence Assessment – General Assessment	
General Assessment	Disruption
Insignificant	Minimal changes that are either absent or not discernible.
Slight	Slight disturbances to the environment and short-term stresses in biota are discernible (below minimum reaction threshold 0.1 % of natural population reaction).
Moderate	Moderate disturbances to the environment and stresses in biota are observed (changes up to 1 % of natural population reaction are feasible).

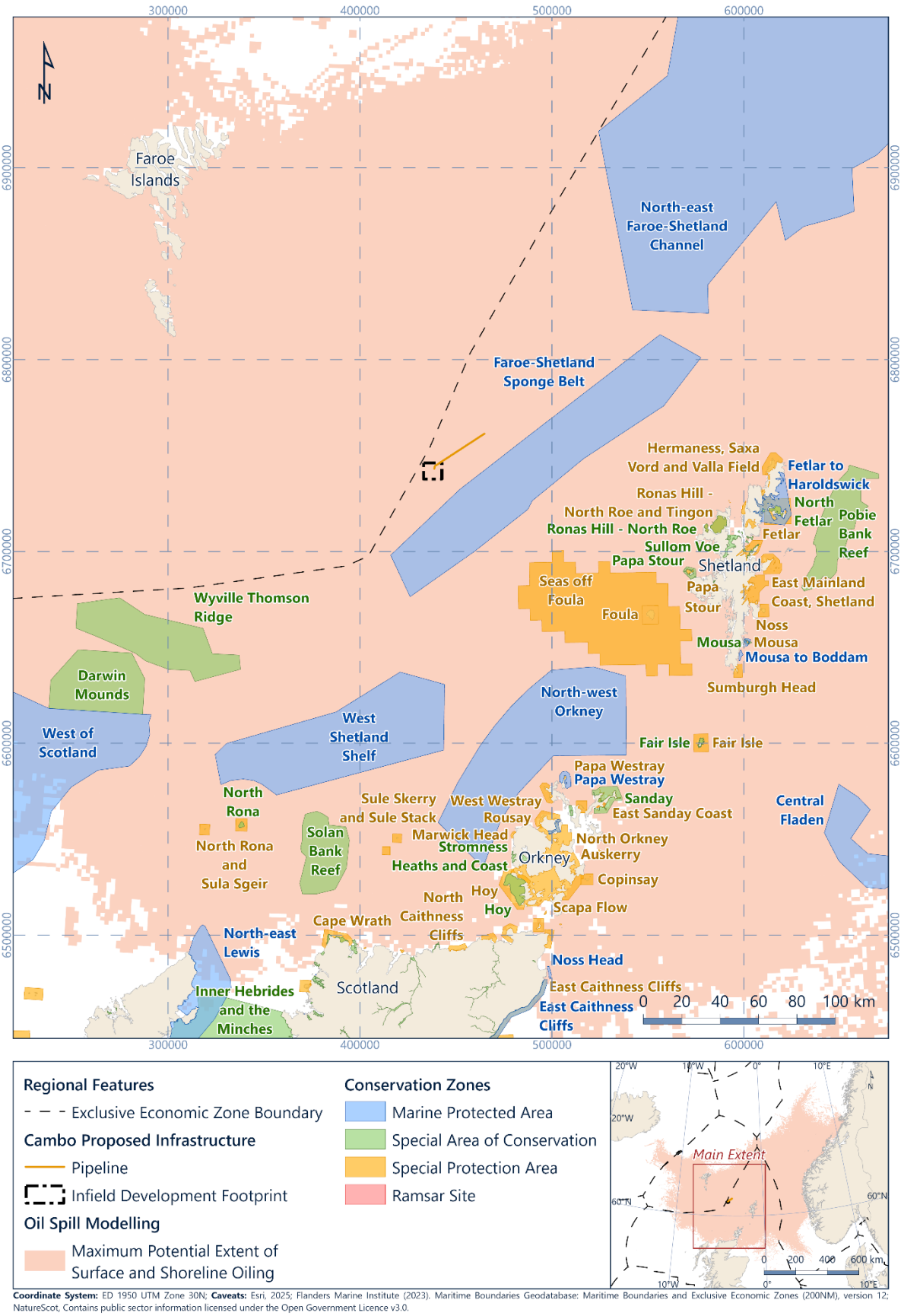
D. Consequence Assessment – General Assessment	
Severe	Severe disturbances to the environment and stresses in biota are observed (up to 10 % of natural population).
Catastrophic	Catastrophic disturbances to the environment and stresses in biota are observed (up to 50 % of natural population). Changes are irreversible and stable structural and functional degradation of a system is evident.

Figure 14.11 details the maximum extent of surface and shoreline oiling. The oil spill modelling results show that the majority of crude oil would be expected to move to the northeast and east, with the coastlines of Shetland and Norway most likely to be affected, followed by the coastlines of the Orkney and Faroe Islands (Section 14.4.3). During spring and summer, in the case of the well blow out scenario, there is also a small probability of an oil slick reaching the north coasts of Scottish mainland or the Island of Lewis. Figure 14.11shows the maximum extent of the area that may become oiled over all four seasons which were modelled. Protected sites which overlap with the maximum potential extent of oiling are also shown in Figure 14.11.

Table 14.6 lists the protected sites that have been shown by the modelling to have the potential to be affected by a large oil spill from the Cambo field development. As shown by the vertical plume modelling (Section 14.4.3; Figure 14.8), oil released from the seabed in the event of an uncontrolled well blow-out would be expected to quickly rise to the sea surface. Therefore, the deep-water benthic habitats, for which marine protected areas in the region are designated (such as the North-East Faroe-Shetland Channel MPA and the Faroe-Shetland Channel Sponge Belt NCMPA) are not expected to be affected in the event of a spill from the proposed field development, and have not been included in Table 14.6 or in Figure 14.11.

The potential impact of surface or shoreline oiling on the habitats and species of the protected sites listed in Table 14.6 has been assessed. As an initial step in the assessment, thresholds have been applied in terms of the minimum arrival time and maximum probability of oiling to screen these protected sites in or out of the MEI assessment.

The modelling results provide a worst-case scenario with the assumption that there would be no intervention in the slick. In practice, oil spill response resources would be mobilised immediately if a spill occurred, and oil spill response efforts would prioritise the protection of sensitive habitats and species. Therefore, it is assumed that sites at which oil would be expected to take more than three weeks to reach, or with a probability of less than 5 % for any oiling to occur, would be very unlikely to be subject to significant adverse effects and consequently can be screened out of the assessment. Therefore, these sites (Copinsay SPA; Noss Head NCMPA; North Caithness Cliffs SPA, East Caithness Cliffs NCMPA, SAC and SPA, Cape Wrath SPA, Hoy SPA and the Inner Hebrides and the Minches NCMPA) have not been considered further in this assessment. The remaining protected sites have been assessed according to the consequence assessment methodology detailed above.



Coordinate System: ED 1950 UTM Zone 30N; **Caveats:** Esri, 2025; Flanders Marine Institute (2023). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 12; NatureScot, Contains public sector information licensed under the Open Government Licence v3.0.

Figure 14.11: Maximum potential surface or shoreline oiling from an uncontrolled well blow-out (a) or crude oil storage tank rupture (b) overlain with protected area (OSRL, 2020a, 2020b; NatureScot, 2023; JNCC, 2025)

Table 14.6: Protected sites which may be impacted by a large oil spill from the proposed Cambo field development

Name	Designation	Location	Well Blow-Out		Complete Loss of FPSO Inventory		Qualifying Features (SAC: Only coastal habitats are listed; SPA: percentage bird populations listed refer to relevant biogeographic area for each species; MPA: Geodiversity Features not listed)
			Maximum Probability	Minimum Arrival Time	Maximum Probability	Minimum Arrival Time	
Hermaness, Saxa Vord and Vall Field	SPA	Coastal, Shetland	89.0 %	7 days 18 hrs	49.0 %	5 days 3 hrs	Breeding seabird assemblage and individual species of international importance (including at least 3 % of red-throated diver, 4.6 % of gannet, 4.6 % of great skua and 2.8 % of puffin)
Seas off Foula	SPA	Offshore Shetland	80.5 %	2 days 12 hrs	25 %	3 days 18 hrs	Breeding seabird assemblage and individual species of international importance (including at least 5 % of Great Skua), as well as migratory seabird assemblage during non-breeding season.
Fetlar to Haroldswick	NCMPA	Inshore, Shetland	60.0 %	11 days 0 hrs	28.0 %	8 days 0 hrs	Biodiversity: black guillemot; circalittoral sand and coarse sediment communities; horse mussel beds; kelp and seaweed communities on sublittoral sediment; maerl beds; shallow tide-swept coarse sands with burrowing bivalves
Fetlar	SPA	Coastal, Shetland	53.0 %	11 days 0 hrs	25.0 %	8 days 0 hrs	Breeding seabird assemblage and individual species of international importance (including at least 1.2 % of Arctic tern, 75 % of UK of red-necked phalarope, 0.8 % of dunlin, 3.8 % of great skua and < 0.1 % of whimbrel)
Foula	SPA	Coastal Shetland with marine component	42.0 %	5 days 0 hrs	9.0 %	5 days 12 hrs	Breeding seabird assemblage and individual species of international importance (including at least 2.5 % of Arctic tern, 0.1 % of Leach's storm petrel, 1.2 % of red-throated diver, 16 % of world population of Great Skua, 1.1 % of guillemot, 5.3 % of puffin and 1.9 % of shag)
North Rona and Sula Sgeir	SPA	Coastal, off mainland Scotland	32.0 %	9 days 21 hrs	5.0 %	12 days 9 hrs	Breeding seabird assemblage and individual species of international importance (including at least 5.0 % of Leach's storm petrel, 1.2 % of

Name	Designation	Location	Well Blow-Out		Complete Loss of FPSO Inventory		Qualifying Features (SAC: Only coastal habitats are listed; SPA: percentage bird populations listed refer to relevant biogeographic area for each species; MPA: Geodiversity Features not listed)
			Maximum Probability	Minimum Arrival Time	Maximum Probability	Minimum Arrival Time	
							storm petrel, 3.4 % of gannet and 1.3 % of guillemot)
Sumburgh Head	SPA	Coastal, Shetland	29.0 %	13 days 15 hrs	3.0 %	12 days 15 hrs	Breeding seabird assemblage and individual species of international importance
Noss	SPA	Coastal, Shetland	26.0 %	18 days 12 hrs	4.0 %	14 days 6 hrs	Breeding seabird assemblage and individual species of international importance (including at least 2.8 % of gannet, 3.0 % of great skua and 1.4 % of guillemot)
Fair Isle	SAC	Coastal, Fair Isle	25.0 %	11 days 12 hrs	5.0 %	10 days 15 hrs	Annex I Habitats: Vegetated sea cliffs of the Atlantic and Baltic coasts
Fair Isle	SPA	Coastal, Fair Isle	25.0 %	11 days 12 hrs	5.0 %	10 days 15 hrs	Breeding seabird assemblage of international importance and breeding species of European importance (including at least 2.5 % of Arctic tern, 100 % of Fair Isle wren and 1.1 % of guillemot)
Papa Stour	SAC	Coastal, Shetland	22.0 %	8 days 3 hrs	6.0 %	7 days 15 hrs	Annex I habitats: reefs; submerged or partially submerged sea caves
Papa Stour	SPA	Coastal, Shetland	22.0 %	8 days 3 hrs	6.0 %	7 days 15 hrs	Individual species of international importance (including at least 2.3 % of Arctic tern)
Sule Skerry and Sule Stack	SPA	Coastal, off Orkney	21.0 %	12 days 21 hrs	< 1.0 %	13 days 9 hrs	Breeding seabird assemblage and individual species of international importance (including at least 0.0 % of Leach's storm petrel, 1.2 % of storm petrel, 1.9 % of gannet and 4.8 % of puffin)
Mousa	SAC	Coastal, Shetland	18.0 %	16 days 12 hrs	2.0 %	16 days 6 hrs	Annex II species: common seal
North Rona	SAC	Coastal, off mainland Scotland	18.0 %	10 days 6 hrs	2.0 %	17 days 18 hrs	Annex II species: grey seal
Papa Westray	NCMPA	Coastal, Orkney	18.0 %	10 days 15 hrs	3.0 %	10 days 15 hrs	Black guillemot

Name	Designation	Location	Well Blow-Out		Complete Loss of FPSO Inventory		Qualifying Features (SAC: Only coastal habitats are listed; SPA: percentage bird populations listed refer to relevant biogeographic area for each species; MPA: Geodiversity Features not listed)
			Maximum Probability	Minimum Arrival Time	Maximum Probability	Minimum Arrival Time	
Sanday	SAC	Coastal, Orkney	18.0 %	11 days 6 hrs	3.0 %	11 days 12 hrs	Annex I habitats: reefs. Annex II species: common seal
Calf of Eday	SPA	Coastal, Orkney	16.0 %	12 days 0 hrs	3.0 %	11 days 3 hrs	Breeding seabird assemblage of international importance
West Westray	SPA	Coastal with marine component, Orkney	14.0 %	11 days 12 hrs	3.0 %	12 days 0 hrs	Breeding seabird assemblage and individual species of international importance
North Caithness Cliffs	SPA	Coastal, mainland Scotland	12.0 %	22 days 18 hrs	N/A	N/A	Breeding seabird assemblage and individual species of international importance (including at least 0.5 % of peregrine falcon and 1.2 % of guillemot)
Marwick Head	SPA	Coastal, Orkney	11.8 %	14 days	N/A	N/A	Breeding seabird assemblage and individual species of international importance (including at least 1.1 % of world population of Great Skua)
Copinsay	SPA	Onshore, Orkney	11.0 %	24 days 6 hrs	N/A	N/A	Breeding seabird assemblage of international importance
East Sanday Coast	SPA	Coastal, Orkney	8.0 %	12 days 6 hrs	3.0 %	11 days 15 hrs	Overwintering species of European importance
Rousay	SPA	Coastal, Orkney	8.0 %	15 days 12 hrs	< 1.0 %	14 days 18 hrs	Individual species of international importance (including at least 2.3 % of Arctic tern)
Cape Wrath	SAC	Coastal, mainland Scotland	4.0 %	15 days 18 hrs	N/A	N/A	Annex I Habitats: Vegetated sea cliffs of the Atlantic and Baltic coasts
Cape Wrath	SPA	Coastal, mainland Scotland	4.0 %	15 days 9 hrs	N/A	N/A	Breeding seabird assemblage of international importance
Hoy	SAC	Coastal, Orkney	3.0 %	19 days 18 hrs	N/A	N/A	Annex I Habitats: vegetated sea cliffs of the Atlantic and Baltic coasts

Name	Designation	Location	Well Blow-Out		Complete Loss of FPSO Inventory		Qualifying Features (SAC: Only coastal habitats are listed; SPA: percentage bird populations listed refer to relevant biogeographic area for each species; MPA: Geodiversity Features not listed)
			Maximum Probability	Minimum Arrival Time	Maximum Probability	Minimum Arrival Time	
Hoy	SPA	Coastal, Orkney	3.0 %	19 days 18 hrs	N/A	N/A	Breeding seabird assemblage and individual species of international importance (including at least 0.5 % of peregrine falcon, 6.0 % of red-throated diver and 14.0 % of great skua)
Noss Head	NCMPA	Coastal, mainland Scotland	2.1 %	32 days 12 hrs	N/A	N/A	Biodiversity: horse mussel beds
East Caithness Cliffs	SAC	Coastal, mainland Scotland	0.7 %	33 days 0 hrs	N/A	N/A	Annex I Habitats: vegetated sea cliffs of the Atlantic and Baltic coasts
East Caithness Cliffs	SPA	Coastal, mainland Scotland	0.7 %	33 days 0 hrs	N/A	N/A	Breeding seabird assemblage and individual species of international importance (including at least 0.5 % of peregrine falcon, 3.2 % of guillemot, 1 % of herring gull and kittiwake, 1.6 % of razorbill and 1.9 % of shag)
East Caithness Cliffs	NCMPA	Coastal, mainland Scotland	0.7 %	33 days 0 hrs	N/A	N/A	Biodiversity: Black guillemot
Inner Hebrides and the Minches	SAC	Marine, off mainland Scotland	0.7 %	22 days 18 hrs	N/A	N/A	Annex II species: harbour porpoise

Notes
Sources: OSRL, 2020a; OSRL, 2020b; NatureScot, 2023; JNCC, 2025.

14.6.2 Sea Surface Oiling

Sections 5.4.5 and 14.5.1.7 describe the sensitivities of birds on the sea surface to oiling, and Figure 5.17 demonstrates that at certain times of year there is potential for increased seabird sensitivity to oil pollution at the site and in the wider vicinity of the proposed Cambo field development. Eighteen of the protected sites listed in Table 14.6 are SPAs designated for the protection of birds listed under Annex I of the Birds Directive. Two NCMPAs are also designated for the protection of black guillemots. The majority of these sites are designated for the assemblage of birds that they support, and some are additionally designated for supporting a significant proportion of the population of certain species. It would be very unlikely for a spill to affect all of these sites, and so it would be expected that in the event of an oil spill affecting one of the sites, population recruitment would occur from other neighbouring sites by the following breeding season. The Fair Isle SPA supports 100 % of the breeding population of Fair Isle wren, and so this species would not be able to recruit from neighbouring populations. However, this species forages inland and would therefore not be expected to be impacted by an oil spill.

Marine mammals may also be sensitive to sea surface oiling, as discussed in Section 14.5.1. The Sanday and Mousa SACs, listed in Table 14.6, are both designated for the protection of common seals, whilst the North Rona SAC is designated for grey seals.

Using the environmental consequence assessment Table 14.5 (Patin, 2004), the assessment of this scenario is summarised in Table 14.7.

Table 14.7: Environmental consequence assessment for sea surface oiling

Scale	Assessment	Justification
Spatial	Sub-regional	Maximum extent of spill as shown in Figure 14.11
Temporal	Long term	Expected recovery by the following breeding season, in around one year
Reversibility	Reversible	The disturbance to the environment would be removed within one year
General	Moderate	Change expected in no more than 1 % of the population

In summary, although potential for recovery would be good, surface oil contamination has the potential to cause a measurable significant adverse effect to protected seabirds and marine mammals. Therefore, there is the potential for a MEI to occur as a result of sea surface oiling at the following protected sites:

- SPAs: Sumburgh Head; West Westray; Fetlar; Foula; Hermaness, Saxa Vord and Valla Field; Seas off Foula; Sule Skerry and Sule Stack; Marwick Head; Noss; North Rona and Sula Sgeir; Calf of Eday; Fair Isle; Papa Stour; Rousay; and East Sanday Coast.
- NCMPAs: Fetlar to Haroldswick; and Papa Westray.

14.6.3 Shoreline Oiling

A number of the SACs listed in Table 14.6 have been designated for the protection of coastal or shallow water habitats. These habitats include reefs (Sanday and Papa Stour), submerged or partially submerged sea caves (Papa Stour) and vegetated sea cliffs of the Atlantic and Baltic coasts (Cape Wrath, Fair Isle and Hoy). Additionally, the Fetlar to Haroldswick NCMPA has been designated for circalittoral sand and coarse sediment communities, horse mussel beds, kelp and seaweed communities on sublittoral sediment, maerl beds, and shallow tide-swept coarse sands with burrowing bivalves. These habitats have varying vulnerability to oiling.

As previously discussed, deeper water benthic habitats are not expected to be affected by oiling. Therefore, reefs, submerged sea cliffs, horse mussel and maerl beds would not be expected to be subject to significant adverse effects.

As discussed in Section 14.5.1, rocky shores are high energy environments which generally have the ability to recover quickly in the event of oiling. Partially submerged sea caves would therefore not be expected to be a vulnerable habitat. Exposure to the sea is a key determinant for which vegetated sea cliff habitats are designated, and this habitat is found in the spray zone of high energy cliffs. However, this small amount of exposure to sea water means that the potential for oil to cause significant adverse effect to this habitat is minimal.

Circalittoral sand and coarse sediment communities, kelp and seaweed communities on sublittoral sediment, and shallow tide-swept coarse sands with burrowing bivalves are all comprised of softer sediments in the tidal zone, which tend to be more vulnerable to the effects of oil spills (Section 14.5.1). This lower energy environment is also likely to take a longer time to recover in the event of significant adverse effect.

The SPAs (and NCMPAs designated for black guillemot) listed in Table 14.6 are considered less vulnerable to shoreline oiling. Breeding and overwintering sites used by birds tend to be on the upper stretches of cliffs or on grassy slopes beyond the high-water mark, and so shoreline oiling is likely to have less of an impact on birds than that on the sea surface.

Using the environmental consequence assessment Table 14.5 (Patin, 2004), the assessment of this scenario is summarised in Table 14.8.

Table 14.8: Environmental consequence assessment for shoreline oiling

Scale	Assessment	Justification
Spatial	Sub-regional	Maximum extent of spill as shown in Figure 14.11
Temporal	Chronic	Expected recovery to soft sediment habitats to take more than one year
Reversibility	Slightly reversible	The disturbance to the environment would take longer than one year to be removed from soft sediment environments
General	Moderate	Change expected in no more than 1 % of the population

In summary, shoreline oil contamination has the potential to cause a measurable significant adverse effect to protected sedimentary shores. Therefore, there is the potential for a MEI to occur as a result of shoreline oiling at the Fetlar to Haroldswick NCMPA.

14.6.4 Conclusion

The MEI assessment shows that a large oil spill from either an uncontrolled well blow out or the complete loss of the FPSO inventory at the Cambo field development will have the potential to cause a measurable significant adverse effect to up to 18 SPAs and 3 NCMPAs due to oil on the sea surface, and to 1 NCMPA as a result of shoreline oiling.

It should be noted however, that this assessment is based on stochastic modelling results. Stochastic modelling results are not representative of the effects of a single spill event but illustrate the potential total geographic range of any oil spill event, based on hundreds of individual spill scenarios using a wide variety of metocean conditions. In the event of an actual oil spill, the affected area(s) will be much more localised, and will depend on the volume of oil spilled and local metocean conditions at the time. Moreover, mitigation measures will be put in place to minimise the footprint of the oil spill as outlined in Section 14.7.

14.7 Mitigation Measures

14.7.1 Preventative Measures

Ithaca Energy's commitment to ensuring protection of the environment is set out in the corporate Health, Safety, and Environmental (HSE) Policy Statement, a copy of which is provided in Section 2 of this Environmental Statement. Ithaca Energy follows the International Standards Organisation (ISO) 14001 standard and has an externally verified Environmental Management System (EMS). The Company's EMS covers activities including exploration, drilling and production and will be applied to the proposed Cambo field development. The EMS governs those aspects of the operations that can be controlled, such as discharges, and establishes a subsequent auditing process.

The activities associated with the proposed development are also covered in a project specific HSE plan which ensures that the project is managed in such a way that Ithaca Energy's HSE Policy is adhered to throughout all phases of the proposed project. Particular emphasis will be paid to having a robust design, quality equipment, quality construction and operational best practices.

In order to prevent an oil spill occurring, stringent safety and operational procedures will be followed at all times.

14.7.1.1 Training, Experience and Suitability of Equipment

Ithaca Energy is aware of the risk of a release of hydrocarbons at the proposed Cambo field development. Before offshore operations commence, Ithaca Energy and their appointed Installation/Well Operator will fully assess the competence and experience of all contractors, and the suitability of all equipment to operate in the West of Shetland area. All offshore personnel will be appropriately trained, experienced and certified to carry out their specific duties. The crew of the FPSO and the MODU will also undergo environmental awareness and safety training.

14.7.1.2 Well Design

All wells in the UK are subject to well examination schemes as per the Offshore Safety Directive 2015. The purpose is to provide assurance that the well is designed and constructed properly and is maintained adequately. This provides a scheme of quality control and quality assurance and incorporates current industry guidance. It is essential for the examination to demonstrate that the pressure boundary of the well is controlled throughout the well's life cycle and that the pressure containment equipment that forms part of the well is suitable for this purpose.

Examination of planned well programmes and operations must be carried out by an independent and competent person. Independent examination ensures that 'Good Oilfield Practice' and company standards are incorporated during drilling and well intervention operations. This contributes to risk reduction and prevention of loss of containment through application of the 'as low as reasonably practicable' (ALARP) principle.

The Cambo wells have been designed to minimise the potential for well control issues. A thorough and formal peer-review approach will be used, to review all critical elements of the well design and the execution of drilling the well. Furthermore, the well design will be independently reviewed by a Well Examiner, as is required for all wells in the UK. The Well Examiner will also monitor the actual construction and any modifications to the well.

Any change, or deviation, to the drilling programme, the subsurface parameters for the well design, or the well construction itself, will be subject to a formal management of change process.

14.7.1.3 Well Control

The MODU will be equipped with a BOP which is rated for pressures beyond the maximum pressure anticipated for the wells being drilled.

The function of the BOP will be to prevent uncontrolled flow from the wells to the surface during drilling by positively closing in the well in the event of an uncontrolled release from the reservoir into the well bore. The BOP is made up of a series of hydraulically operated rams that can be closed in an emergency from the drill floor, or from a safe location elsewhere on the rig.

The integrity of the BOP will be tested prior to usage and periodically during the drilling. Inspection and testing of the BOP will be undertaken in line with the Installation/Well Operator, Ithaca Energy procedures and UK legislation.

In the event of any well control issues the Ithaca Energy Well Incident Response Plan will be activated and used as a guide in the event of a well control emergency during operations involving a MODU. The Well Incident Response Plan provides a contingency plan and guidance for the application of equipment and procedures to various well control scenarios. These range from routine well control operations to situations involving the total loss of well control.

The available response options will include, but are not limited to, well control specialists and engineering support; specialist equipment and services; intervention procedures; well kill procedures; relief well planning and execution; Remotely Operated Vehicle (ROV) intervention; capping stack deployment; hydrocarbon containment and subsea dispersant resources. A well control event may not require all of the responses listed.

The Oil Spill Prevention and Response Advisory Group (OSPRAG) capping device is available for use on the Cambo wells if it is determined to be a suitable and effective response to the incident at the time. In addition to well capping the drilling of a relief well may be required (Section 14.7.2).

The suitability of a capping device strategy will be significantly dependent on the circumstances of the incident and scenario encountered. In the unlikely event of a blow out from a subsea well where the primary Blowout Prevention Equipment has failed, a well capping device may be required. Ithaca Energy has access to the OSPRAG Capping device in the event it is required.

14.7.1.4 Other Safety Measures

All equipment used on the MODU will have safety measures built in, to minimise the risk of any hydrocarbon spillage (e.g. open and closed drain systems). A number of spill kits will be available to deal with (smaller) spillages. All supply vessels will operate via Dynamic Positioning (DP), to reduce likelihood of collision and therefore potential tank rupturing.

14.7.1.5 Flowline Maintenance and Control

The flowline and umbilicals associated with the Cambo field will be subject to a rigorous inspection and maintenance regime, to ensure they are kept in optimum condition through the life of the field. Periodic flowline surveys, comprising ROV inspections, and an inspection repair and maintenance plan will be in place. Inspection intervals will be reviewed following receipt of inspection information and, where appropriate, future intervals are adjusted.

14.7.2 Action to Stop a Subsea Spill During Drilling with the MODU

14.7.2.1 Initial Actions

The initial response to a subsea spill will be to use the ROV to identify the source of the leak. However, if at any time the safety of the MODU becomes compromised, the first priority will be to close the BOP, disconnect the MODU from the well, and move off location. While the BOP is designed as fail safe closed, ROV and acoustic overrides are available should this not work correctly. This will allow the BOP to be closed within 24 hours, even if the MODU has to move off location first. Once at a safe distance from the well location, the ROV can be deployed to verify the BOP is properly closed, and no more oil is being spilled.

A second rig or intervention vessel would be mobilised to the location with the intention of placing a second BOP or a capping device on the flowing well or by drilling a relief well and re-establishing well control. As a member of OSRL, Ithaca Energy will have access to the OSPRAG well capping device to contain the well (Section 14.7.1.3).

14.7.2.2 Drilling a Relief Well

If primary and secondary well control is lost by way of a blowout and oil flows uncontrollably from the well, a relief well may be required to stop the flow of oil and bring the well back under control. A suitable rig would be sourced from the UK market. An inventory is maintained by Ithaca Energy and their contractors to ensure that stocks of all materials required for a relief well are available at short notice. Ithaca Energy has insurance provisions in place to cover well control/re-drill situations as well as legal liabilities, and the Company is a member of Offshore Pollution Liability Association Limited (OPOL) which provides rapid compensation to parties directly affected by an oil spill.

In a situation where the MODU is not disconnected from the well, and depending on the stage of operations a blow-out occurs, there may be various other methods available to control the flow of hydrocarbons to the surface. These include varying the pump rate and the use of various chemicals, such as weighting material (barite or calcium carbonate) and cement. Therefore, a contingency stock of cement and barite will be kept onboard the MODU. Although the time required to kill the well will be dependent on how and why it has failed, a standard well kill operation takes between 12 and 48 hours. Once control of the well has been regained, the well can be fully abandoned with cement plugs.

14.7.3 Oil Spill Response

If a well control incident were to occur, it would be a priority to avoid spilled hydrocarbons impacting the coastline and, therefore, Ithaca Energy would employ all available and suitable oil spill response techniques in the event of a spillage moving towards the shore.

14.7.3.1 Oil Pollution Emergency Plan

OPEPs will be required for the Cambo field development. OPEPs must conform to the Merchant Shipping (Oil Pollution, Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015 and the Offshore Installations (Emergency Pollution Control) Regulations 2002.

Ithaca Energy must ensure that any MODU working in the Cambo field has an approved Non Production Installation Oil Pollution Emergency Plan (NPI OPEP) in place. Ithaca Energy must also have in place an approved TOOPEP to cover the planned drilling operations.

During production operations, Ithaca will have a Cambo Field (Tier 1) OPEP in place. A copy of this OPEP will be held on the Cambo FPSO. In addition, Ithaca has in place an Onshore OPEP detailing Tier 2/3 response arrangements.

The respective OPEPs set out the specific oil spill response requirements for the Cambo field development, taking into account the location, the prevailing meteorological conditions and the environmental sensitivities of the area. The OPEPs will be designed to assist the decision-making process during a hydrocarbon spill, indicate what resources are required to combat the spill, steps to minimise any further discharges and mitigate its effects.

14.7.3.2 Training, Exercises and Experience – Offshore Personnel

Specific members of the MODU, FPSO and standby vessel crew will have undertaken appropriate OPEP level oil spill response training. The Offshore Installation Manager (OIM) and the Installation/Well Operator offshore representative will have undertaken the OPRED course for On-Scene Commander (OPEP Level 1).

As a minimum, the TOOPEP and a Field OPEP will be distributed to personnel with designated duties in the event that an oil spill response is required, and to the regulatory authorities and statutory consultees. On receipt of the TOOPEP and Field OPEP, personnel will undergo awareness training in oil spill response prior to the commencement of drilling operations.

The crew of the MODU and FPSO will regularly undertake training exercises, including vessel-based oil spill response exercises and an OPEP Exercise while on site, to ensure that offshore personnel are familiar with the OPEPs and their responsibilities during a response.

14.7.3.3 Training, Exercises and Experience – Onshore Personnel

External oil spill response training will be organised for key onshore personnel, in line with the OPRED requirements and the internal requirements of environmental training and continual improvement in Ithaca Energy's Management System. Relevant Ithaca Energy Duty Managers will, as a minimum, have undertaken the OPRED course, Corporate Management oil spill response awareness (OPEP Level 2). Ithaca Energy is a member of OSRL, and a response advisor with OPEP Level 4 training would also be provided by OSRL.

Desktop exercises will be undertaken prior to commencement of operations to test the effectiveness of the TOOPEP and Field OPEP. Ithaca Energy will conduct these oil spill response exercises to ensure that all personnel are aware of their roles in an actual oil spill incident. The exercises will also familiarise personnel with the lines of communication between the MODU, offshore, the Installation/Well Operator and Ithaca Energy representatives onshore. The exercises will include familiarisation of the roles and responsibilities of the various interested parties, and the chosen response strategies. If necessary, the TOOPEP and/or Field OPEP will be updated to reflect any changes required as a result of these exercises.

14.7.3.4 UK Mutual Aid Framework Agreement

Ithaca Energy is a signatory to the UK Mutual Aid Framework Agreement (MAFA) which facilitates mutual aid of personnel between UK Operators in the event of a sustained incident response. This initiative will allow for the potential sharing of specialist expertise and support between participating members.

14.7.4 Oil Spill Response Strategies

The most appropriate response to a hydrocarbon spill from the planned drilling operations will be determined by oil type, logistics and prevailing physical conditions. A precise response strategy, which may employ one or more of the response options described below, can only be decided at the time of the spill. Oil spill response personnel must be prepared to adapt their actions as the spill develops, as changes in both the prevailing conditions and the oil properties dictate.

In general, there are four groups of response strategies which could be deployed in the event of an oil spill:

- Natural dispersion and monitoring;
- Application of chemical dispersants;
- Containment and recovery (surface and subsea); and
- Shoreline protection and clean-up.

14.7.4.1 Natural Dispersion and Monitoring

In the early stages of an incident, a standby vessel will be on site for monitoring and surveillance of the slick. Aerial surveillance may also be undertaken by helicopter or aircraft depending on the size of the spill. Manual predictions and oil spill modelling software to estimate the movement of the oil will be employed using real time parameters to assist with the predictions.

14.7.4.2 Application of Chemical Dispersants

Chemical dispersants will be considered to aid natural dispersion of a large oil spill, or when sensitive receptors such as flocks of seabirds are at risk. The decision to use chemical dispersants will assess its positive benefits, against any resulting impacts in the water column.

14.7.4.3 Containment and Recovery

Booms may be used to contain a large slick on the sea surface, concentrating the oil for recovery by skimmers. The effectiveness of both booms and skimmers will be assessed for their suitability.

14.7.4.4 Shoreline Protection and Clean-up

In the event of a spill, the first priority should be to prevent spilled hydrocarbons from reaching coastal areas. If spillage is projected to reach the shoreline with the use of manual and software predictions, coastal sensitivities will be identified. OSRLs Geographic Information System (GIS) facility (which maps coastal sensitivities around the UK) will supplement local authority plans, strategy documents, maps, and other available resources. Broad-scale surveys, from vehicles, inshore vessels or helicopters, will be mobilised to gain an overview of the shoreline types and main sensitivities along the potentially affected stretch of coast, and consideration will be given to carrying out more detailed surveys of particularly environmentally sensitive or commercial important areas of shoreline prior to any oil beaching. The strategy for shoreline clean-up

ultimately will be directed by the affected local authorities. Appropriately trained personnel and clean-up equipment will be made available to assist any clean-up operations, through OSRL.

14.7.5 Liability and Insurance

Ithaca Energy will ensure that it has sufficient finances and insurance in place to cover the cost of responding to a large oil spill (including the use of a well capping device and drilling a relief well, if required). Ithaca Energy is a member of the OPOL. OPOL is a voluntary oil pollution compensation scheme to which all offshore operators currently active on the UKCS are party to. OPOL is accepted as representing the committed response of the oil industry in dealing with compensation claims arising from offshore oil pollution incidents from exploration and production facilities. At present the OPOL Limit of Liability is US $250 million per incident.

Based on an oil spill modelling study undertaken on behalf of the OSPRAG, the current occurrence limit should be sufficient to cover the third-party pollution compensation and remediation costs associated with the majority of spill scenarios, with only a small number of wells on the UKCS having the potential to exceed the OPOL Limit (OGUK, 2012).

While OPOL provides for third party clean-up and compensation costs to a predetermined limit, there may be additional extra expenses that the Ithaca Energy, as the Licence Operator, may have to cover in the event of a blow-out. Ithaca Energy will ensure that sufficient finance or insurance/indemnity provision is available to cover the drilling of relief wells (if required).

14.8 Catastrophic Loss of the FPSO, MODU, a Vessel or the Helicopter

Under extreme circumstances, the FPSO, MODU, a support vessel or a helicopter may sink. This could be caused by a variety of reasons, such as a serious blow-out situation, shallow gas release, a collision with another vessel, a freak weather event or other natural disaster, a catastrophic error during ballasting or offloading of the FPSO or ballasting of the MODU. These events are extremely rare and happen so infrequently that no reliable statistics could be obtained to quantify them.

A raft of mitigation measures are in place for preventing such an event from happening. These include all mitigation measures mentioned in Section 14.7 above, as well as the following:

- The MODU will be inspected for sea worthiness and the Well Operator/Installation Operator audited prior to operations commencing;
- Personnel will be appropriately trained, experienced and certified;
- The competence and experience of all contractors will be assessed before they are contracted;
- All supply vessels will operate via DP, to reduce the likelihood of a collision;
- A digital site survey for drilling hazards has been carried out to confirm that there is no shallow gas in the area;
- A 500 m exclusion zone will be enforced around the MODU for general shipping in the area;

- A standby vessel will be on site through the life of the field to enforce the 500 m exclusion zone;
- The MODU and associated vessels will display appropriate marking and lighting;
- The suitability of supply, other support vessels and the helicopter will be assessed before they are contracted;
- The standby vessel will be equipped with radar and communication equipment so that any vessel in the area can be detected and contacted, if required; and
- The United Kingdom Hydrographic Office (UKHO) will be kept informed of drilling activities.

In the event of the loss of the FPSO, the MODU, a support vessel or a helicopter, it would be unlikely that the vessel or aircraft would be salvageable in this deepwater environment and, therefore, would most probably remain on the seabed as a wreck. Attempts would be made to salvage any remaining hydrocarbons and other potentially harmful products onboard the FPSO/MODU/vessel, although it should be noted that, in practice, these types of operations are prone to causing pollution incidents. The potential impact of the release of oil to the marine environment is described above in Section 14.5.

The wreck of the FPSO, MODU, vessel or helicopter would be marked on navigational charts. In general, the presence of wrecks on the seabed is not considered to have any long lasting negative environmental effects. Therefore, given the remote chance of such an event happening due to appropriate mitigation measures in place, and minimal negative long-term environmental impacts, the residual impact of a loss of rig is considered to be insignificant.

14.9 Resilience to Natural Disasters and Climate Change

The potential for natural disasters such as earthquakes and tsunamis are very low as these events are themselves rare however they cannot be discounted (Long, 2015). Nonetheless, the infrastructure of the proposed development must be able to withstand the rigours of the North Sea environment.

As a result of climate change, more extreme weather events have been recorded in recent years, this is in conjunction with rising sea levels. The effects of climate change may affect storminess, storm tracks as well as wind and wave heights (Bricheno et al., 2025). Modelling studies predict that, with respect to the UK, there may be a weakening of storm tracks during the summer months but an increase in winter storms both in terms of frequency and intensity (Bricheno et al., 2025). The effects of climate change must therefore be considered when embarking on projects such as the Cambo field development.

To this end, the above sea and subsea infrastructure used in the Cambo field development will be structurally sound, designed to withstand a number of different loads and extreme weather events. Safety procedures will also be implemented, such as making the operations/installations safe or potentially shutting down operations, if such extreme weather events are experienced. This is in combination with emergency procedures described in TOOPEP and OPEP.

14.10 Conclusions

The risk of a large-scale hydrocarbon spill during drilling operations or during the subsequent production phase of the proposed Cambo Field Development is considered to be very low. Historic spill data shows that large (crude) oil spills from oil and gas installations are very rare on the UKCS, and the overall volume spilled each year continues to reduce gradually over time. There has never been an oil spill as a result of a well blow-out on the UKCS.

Between 1990 and 2024, a total of 19 spills greater than 25 tonnes have been recorded from MODUs on the UKCS (Section 14.2). Historic data suggest small spills of less than 1 tonne represent the most likely spill scenarios. The largest oil spills (> 25 tonnes) from MODUs were mostly related to OBM discharges, with only 2 recorded crude oil spills of this size during the period 1990-2024. As discussed in Section 4.4.3, LTOBMs may be used during the drilling of the lower sections of the production wells. Any spent LTOBM will be collected onboard the MODU and shipped to shore for treatment and disposal. Alternatively, cuttings contaminated with LTOBM will be thermally treated before they are discharged to the marine environment. Therefore, any discharge of LTOBM is not considered likely to lead to a release of oil. Large oil spills from FPSOs are also very rare, with only 60 spills over 1 tonne from a total of almost 1,100 spills from FPSOs in the period 1990-2024 (Section 14.3).

The oil spill modelling scenario shows that a large spill, such as from a well blow-out or a complete loss of inventory from the FPSO, would, under the majority of meteorological circumstances, drift northeast of the proposed well locations. A large oil spill would have the potential to reach the coasts of Shetland, Orkney, Faroe Islands or Norway, and during spring and summer time there would be a small probability of oil beaching on the north coast of mainland Scotland and the Isle of Lewis as well. These conclusions are based on modelling results that assume no intervention in the slick. In practice oil spill response resources would be mobilised immediately if a spill occurred. It would be a priority for Ithaca Energy and the Installation/Well Operator to attempt to ensure no spilled oil would impact the coastline and, therefore, all appropriate oil spill response techniques would be employed in the event of a spillage moving towards the shore.

It should be noted that these potential impacts would only occur under extreme circumstances in the event of a very large oil spill, as modelled in this ES. Historic data on oil spills from MODUs and FPSOs installation operating on the UKCS show that there have only been two crude oil spills of such a large size (112 tonnes and 685 tonnes) in the period 1990 to 2024. These spills occurred in 1990 and 1997. Historic data suggest small spills of less than 1 tonne represent the most likely spill scenarios.

Throughout the life of field, the focus will be on the prevention of oil spills. Stringent safety and operational procedures will be adhered to throughout the operations. A robust well design has been developed to minimise the potential for well control issues, and all critical elements of this design and the execution operations have been both peer and independently reviewed.

Ithaca Energy will ensure that detailed operation specific OPEPs are in place, to enable immediate and appropriate action is taken in the event of any hydrocarbon spillage, minimising any impact to the marine environment. A contract with OSRL is in place, allowing the rapid deployment of oil spill response equipment and personnel in the event of a large oil spill incident. Specific response equipment would be available including booms, to contain surface spills at sea or protect sensitive shorelines. Ultimately, the type and size of spill, along with the metocean conditions at the time of the spill, will dictate which of these resources is most suitable for the spill event. Additional shore clean-up equipment is also available.

The assessment considers that an accidental release of hydrocarbons has the potential to result in impacts of '**Moderate adverse**' to '**Major adverse**' significance. However, with the measures in place to prevent an oil spill incident from happening and the oil spill contingency planning and response resources available to Ithaca SP E&P Limited as Well Operator and the appointed Installation Operator in the event of a large oil spill event, the likelihood of such an event is '**Remote**' and the environmental risk of a release of oil from the proposed Cambo field development is judged to be '**Not Significant**'.

15. Conclusions

Ithaca SP E&P Limited (Ithaca Energy) proposes the development of the Cambo oil field in Blocks 204/4a, 204/5a, 204/9a and 204/10a, in the West of Shetland region of the United Kingdom Continental Shelf (UKCS). The proposed infield development location is centred approximately 133 km to the west of the Shetland Islands, in a water depth of 1,073 m to 1,105 m.

The proposed development comprises three subsea drill centres with nine production wells in total, four water injection wells and a gas export pipeline. Consideration will also be given for an optional dedicated appraisal well, which could assist with the optimisation of the well locations in the southwest of the Cambo field. The wells will be drilled using a Mobile Offshore Drilling Unit (MODU).

Hydrocarbons will be produced from the three drill centres using a Floating Production, Storage and Offloading vessel (FPSO). Oil will be exported via shuttle tanker, whilst gas will be exported via a 32.5 km pipeline which ties into the Rosebank Gas Export Pipeline (GEP) (subject to commercial negotiations). The proposed GEP would pass through UKCS blocks 204/5b, 205/1b and 205/2b. Ithaca SP E&P Limited is the appointed Well Operator for the proposed Cambo field development. An application to appoint an Installation Operator will be made at a later date.

All operational activities undertaken on behalf of Ithaca Energy will be managed under the appointed Installation/Well Operator's Environmental Management System.

Ithaca Energy is currently planning to commence offshore development activities at the Cambo field in Q2 2028, with first drilling operation in Q3 2028. First oil is expected in 2030. The well clean-up operations from the FPSO may require some flaring.

Ithaca Energy plans to use water-based mud (WBM) or / and low toxicity oil based mud (LTOBM) in the drilling operations. Spent WBM will be discharged to sea. Any cuttings containing LTOBM will not be discharged to see unless they contain less than 1 % oil (in weight) on them. Any LTOBM contaminated cuttings will either be contained and shipped to shore for appropriate treatment and disposal or they will be thermally treated offshore and disposed to sea.

The proposed Selection Options are presented in Section 3, Project Description in Section 4, Environmental Description in Section 5, Impact Identification in Section 6 and Impact Assessment Methodology in Section 7. All potentially significant environmental impacts assessed in Section 8 to Section 14. The key environmental concerns identified as requiring consideration for impact assessment were:

- Physical Presence (Section 8);
- Atmospheric Emissions (Section 9);
- Drilling Discharges (Section 10);

- Produced Water and Marine Discharges (Section 11);
- Underwater Noise and Wildlife Disturbance (Section 12);
- Waste Management (Section 13);
- Accidental Events (Section 14).

The main issues identified and conclusions on their residual impacts following the incorporation of mitigation measures are summarised below.

15.1 Physical Presence

The physical presence of infrastructure on the seabed for the duration of the proposed Cambo field development and the vessels involved in the installation and production operations have the potential to minorly affect seabed habitats and other users of the sea.

The proposed Cambo field development will traverse an area of 'offshore subtidal sands and gravels' Priority Marine Feature (PMF) habitat resulting in habitat take, habitat alteration, and seabed disturbance. The spatial extent of the predicted effects of the infrastructure installation and operation will be very small within the context of the wider habitat, as it is widely distributed in UK waters. Effects of habitat take, habitat alteration, and seabed disturbance will last for as long as the infrastructure remains in place. A Comparative Assessment will be undertaken to assess all potential decommissioning options available for the gas export pipeline at the time, including complete recovery of the pipeline as well as leaving sections of the pipeline in-situ. Therefore, effects of the physical presence of the proposed field development on this feature will be long term, but will be highly localised and will have no significant effects on the conservation of this PMF habitat.

Any effects on other local seabed communities will be very small in size and will last for the duration of the development, for as long as the infrastructure remains in place. Impacts will cease on decommissioning when any infield infrastructure placed upon the seabed will be removed, after which the seabed communities are expected to recover to baseline conditions over time.

The proposed location of the infield infrastructure and gas export pipeline (GEP) is not associated with significant fishing or vessel traffic activity and so is highly unlikely to permanently displace or interfere with fishing, shipping, and navigation. Consideration will be given to installing reflectors on the mooring ropes of the FPSO to allow fishing vessels to avoid entanglement with the FPSO, while a guard vessel will be present, as required, during construction activities. A safety vessel will be available throughout the operational phase to ensure other vessel users maintain a safe distance from the infrastructure. Some exclusion from fishing grounds around the immediate area of the pipelaying vessel may occur during pipe laying, but this will be temporary lasting for the duration of the pipe laying operation, estimated to be 27 days. Also, the pipe laying vessel will be continuously moving along the pipeline route and so long-term obstruction and exclusion at any one location will not occur. Effects on fishing, shipping, and navigation due to the physical presence of the proposed field development are therefore considered to be not significant.

15.2 Atmospheric Emissions

Atmospheric emissions will be produced during drilling, installation and production operations, as a result of power generation onboard the MODU and FPSO, as well as on the standby vessel, supply vessels, subsea construction vessel, pipeline laying vessel and helicopter activity. There will be no routine flaring or venting, but some limited non-routine flaring may be required occasionally, for example during process upsets. In addition, emissions will be generated during the transportation, distribution and processing (refining) of the produced Cambo hydrocarbons and ultimately also during the combustion of the processed and / or refined oil and gas products by the end user. All these emissions will contribute to local, regional and global environmental effects.

At local and regional levels, air pollution impacts are mitigated by Health and Safety measures in place to control emissions, the dispersive nature of the offshore environment, and the lack of sensitive receptors in the area. As such, any local and regional air pollution effects are expected to be 'Negligible' to 'Minor adverse', and thus not significant.

The greenhouse gas (GHG) emissions from Cambo will also contribute cumulatively to global climate change effects. With regard to these cumulative GHG emissions, the contribution of the proposed Cambo field development and its associated emissions is comparable to similar oil and gas extraction operations and its greenhouse gas emissions intensity per produced barrel of oil will be on the lower end compared to all other oil and gas installations operating on the UKCS. Moreover, the proposed Cambo field development and its associated emissions are in line with, and do not put at risk, the current energy transition trajectory towards Net Zero by 2050, as followed by the UK government through its Balanced Pathway strategy, as well as with the objectives agreed in the Paris (climate) Agreement. These targets are implemented in the UK by law and put into practice through nationally determined contributions, the North Sea Transition Deal, and industry guidance.

Therefore, in this context, the effects of the overall contribution of all combined Cambo emissions generated during the drilling, installation, commissioning and operational life of field of the Cambo field development (Scope 1 and Scope 3, Category 4 and 6 emissions), as well as those generated during the transportation, distribution and processing (Scope 3, Category 9 and 10 emissions) and end user combustion (Scope 3, Category 11 emissions) of the produced hydrocarbons on global climate change have been assessed as being 'Minor adverse' and in line with the measures necessary to achieve the UK's (as well as the global) trajectory towards net zero and thus can be considered to be not significant.

15.3 Drilling Discharges

The drilling discharges from the proposed drilling operations associated with the proposed Cambo field development have the potential to cause moderate effects (change in habitats and biological communities within the footprint of the development) in the immediate vicinity of the well locations, primarily through physical changes to the seabed.

As a general rule, effects of WBM and cuttings discharges on the benthic environment are related to the total quantity discharged and the energy regime encountered at the discharge site, particularly the currents close to the seabed itself. Based on these factors, the discharge of cuttings, mud and cement at the proposed Cambo wells have the potential to cause a localised impact to the benthic environment, primarily through direct physical changes to the seabed.

Evidence from long-term monitoring at other wells drilled West of Shetland at the Laggan field, indicated that recovery of megafaunal assemblages in the wider area was noticeable after a few years, but full recovery of megafaunal assemblages in areas directly affected by cuttings was slower and might take > 10 years.

As a conservative estimate, it is expected that all benthos will be lost within the area with cuttings deposits > 50 mm, which is < 200 m from each well, representing a very small fraction of the available local habitat in the wider project area. Beyond this immediate area of effect, survival rates will increase with decreasing cutting deposition thickness.

The Scottish PMF 'offshore subtidal sands and gravels' habitat is present within the proposed Cambo field development and it is a 'High' value receptor due to its' national conservation importance. However, as already mentioned, both the physical and chemical impact of the discharges are considered as not significant due to their limited dispersion.

No effects are predicted on the Faroe-Shetland Sponge Belt found > 14 km away from the proposed Cambo field development. No cumulative or transboundary effects are expected.

15.4 Produced Water and Marine Discharges

The fate of produced water discharges has been subject to detailed numerical modelling which shows that plumes will be diluted to below the Risk Based Approach (RBA) threshold from 187 m and up to ~4,404 m of the discharge point as a worst-case scenario. Any environmental effects of produced water discharged at the proposed Cambo field development are expected to be limited, although ultimately this can only be definitively confirmed once the constituents of the produced water at Cambo are known and are demonstrated to have a PEC:PNEC ratio of ≤ 1. The modelling results have influenced the design parameters of the produced water outfall, so that appropriate mitigation is built into the design of the outfall (i.e. discharge temperature, release depth and discharge orientation at a downwards angle).

Only industry standard production chemicals will be used and discharged during operations at the Cambo field. All chemicals used will be included in the Offshore Chemical Notifications Scheme (OCNS) and the most environmentally friendly options evaluated, and where possible chemicals that Pose Little or No Risk (PLONOR) to the environment will be used. Additionally, chemical risk assessments will be undertaken as part of the environmental permitting process.

Significant interaction with seabed sediments and communities are highly unlikely due to the rapid dilution rates within receiving waters and the buoyant nature of the plumes so that they will remain near to the sea surface. Other oil and gas facilities are located far beyond the point

at which plumes are diluted to below RBA threshold such that potential mixing of respective plumes and potential synergistic effects are highly unlikely to occur. Consequently, significant effects on the interests of the Faroe-Shetland Sponge Belt NCMPA (located 16 km away from Cambo) are not forecasted to occur and associated conservation objectives are not expected to be significantly affected.

The potential of marine invasive non-native species (MINNS) being released to the water through ballast water discharges was also assessed. The impact of any marine discharge (ballast water release) from the potential use of a MODU or FPSO coming from international waters was assessed as a worst-case scenario on the receiving water column communities, during the different stages of the development. However, considering that the MINNS species recorded around Shetland are from coastal waters, as well as the remote location of the proposed Cambo field development, the impact is considered as not significant.

In conclusion, significant effects of the discharge of produced water on benthic and water column communities either alone or cumulatively with other discharges in the region are not expected.

15.5 Underwater Noise and Wildlife Disturbance

Anthropogenic noise from shipping, and potentially also from existing oil and gas installations, is currently believed to be the main source of anthropogenic background noise in the area of the proposed Cambo field development. The addition of (mainly) low frequency noise generated by the MODU and subsequently by the FPSO and their support vessels, will add to the overall anthropogenic underwater noise footprint in the area. No good practice guidelines exist in the UK for drilling or production activities since these are thought to be of low concern in terms of disturbance to cetaceans. Consequently, these are not expected to cause any significant impacts on marine mammals potentially present in this area.

In addition, the planned Vertical Seismic Profiling (VSP) survey for the optional appraisal well may cause avoidance responses and other, more subtle, behavioural reactions in cetaceans within a few hundreds of metres of the seismic operations. Given the short duration of these operations (1 day), any such effects are expected to be transient and of 'Minor adverse' significance and, consequently, are not considered to be significant.

15.6 Waste Management

Several different waste streams will be generated throughout the development's lifespan. Waste management will be undertaken in compliance with current environmental legislation and the company's own waste procedures which includes the waste hierarchy, as described above. The management of offshore waste generated on the UKCS is strictly regulated and the UK has well-established infrastructure in place to manage this waste effectively. Therefore, no significant impacts (including in combination, cumulative or transboundary impacts) are anticipated as a result of the Cambo field development.

15.7 Accidental Events

The risk of a large scale hydrocarbon spill during drilling operations, or during the subsequent production phase of the proposed Cambo field development is very low. Historic spill data shows that large (crude) oil spills from oil and gas installations are very rare on the UKCS, and the overall volume spilled each year continues to reduce gradually over time.

The oil spill modelling scenario shows that a large spill, such as from a well blow-out or a complete loss of inventory from the FPSO would, under the majority of meteorological circumstances, drift northeast of the proposed well location. A large oil spill would have the potential to reach the coasts of Shetland, Orkney, Faroe Islands or Norway, and during spring and summer time there would be a small probability of oil beaching on the north coast of mainland Scotland and the Isle of Lewis as well. These conclusions are based on modelling results that assume no intervention in the slick. In practice oil spill response resources would be mobilised immediately if a spill occurred. It would be a priority for Ithaca Energy and the Installation/Well Operator to attempt to ensure no spilled oil would impact the coastline and, therefore, all appropriate oil spill response techniques would be employed in the event of a spillage moving towards the shore.

It should be noted that these potential impacts would only occur under extreme circumstances in the event of a very large oil spill, as modelled in this Environmental Statement (ES). Historic data on oil spills from oil and gas installation operating on the UKCS show that there have only been two crude oil spills of such a large size (112 tonnes and 685 tonnes) in the period 1990 to 2024. These spills happened in 1990 and 1997. Historic data suggest small spills of less than 1 tonne represent the most likely spill scenarios.

Throughout the life of field, the focus will be on the prevention of oil spills. Stringent safety and operational procedures will be adhered to throughout the operations. A robust well design has been developed to minimise the potential for well control issues, and all critical elements of this design and the execution operations have been both peer and independently reviewed.

The Installation/Well Operator will have a detailed operation specific Oil Pollution Emergency Plan (OPEP) / Temporary Operations Oil Pollution Emergency Plan (TOOPEP) in place, to ensure that immediate and appropriate action is taken in the event of any hydrocarbon spillage, minimising any impact to the marine environment. A contract with Oil Spill Response Limited (OSRL) is in place, allowing the rapid deployment of oil spill response equipment and personnel in the event of a large oil spill incident. Specific response equipment would be available including booms to contain surface spills at sea or protect sensitive shorelines. Ultimately, the type and size of spill, along with the metocean conditions at the time of the spill, will dictate which of these resources is most suitable for the spill event. Additional shore clean-up equipment is also available.

With the measures in place to prevent an oil spill incident from happening and the oil spill contingency planning and response resources available to the Well Operator/Installation

Operator in the event of a large oil spill event, the residual environmental risk posed by the proposed Cambo field development is judged to be not significant.

Under extreme circumstances, the FPSO, MODU, a support vessel or a helicopter may sink. This could be caused by a variety of reasons, such as a serious blow-out situation, shallow gas release, a collision with another vessel, a freak weather event or other natural disaster, a catastrophic error during ballasting or offloading of the FPSO or ballasting of the MODU. These events are extremely rare and happen so infrequently that no reliable statistics could be obtained to quantify them. Appropriate mitigation measures will be put in place for preventing such an event from happening.

In the event of the loss of the FPSO, the MODU, a support vessel or a helicopter, it would be unlikely that the vessel or aircraft would be salvageable in this deepwater environment and, therefore, would most probably remain on the seabed as a wreck. Attempts would be made to salvage any remaining hydrocarbons and other potentially harmful products onboard the FPSO/MODU/vessel, although it should be noted that, in practice, these types of operations are prone to causing pollution incidents. The wreck of the FPSO, MODU, vessel or helicopter would be marked on navigational charts to prevent the snagging of fishing nets and other towed equipment. Given the remote chance of such an event happening due to appropriate mitigation measures in place, and minimal negative long-term environmental impacts, the residual impact of a loss of rig is considered to be insignificant.

15.8 Overall Conclusions

The only potentially significant impact identified in this ES is that of a large-scale oil spill. However, the probability of such a spill is very low and mitigation and management procedures will be in place to prevent this from happening, as well as adequate resources to deal with any such spill should it occur. Therefore, with these mitigation measures in place the residual environmental risk of a large oil spill is judged to be 'Not Significant'.

The drilling discharges have the potential to cause moderate effects in the immediate vicinity (< 200 m) of the well locations through physical changes to the seabed, due to the presence of the PMF habitat 'offshore subtidal sands and gravel'. However, the area with a direct impact is relatively small and limited around 200 m from each well and therefore the effect is not significant.

The proposed Cambo field development will contribute to the United Kingdom's Energy Security by maximising recovery of hydrocarbons from the United Kingdom Continental Shelf, whereby it is recognised that the emissions associated with the proposed Cambo field development will contribute to global climate change. However, as discussed above, these emissions are aligned with the current energy transition trajectory towards Net Zero by 2050 set out by the UK government as well as with the objectives agreed in the Paris (climate) Agreement. Therefore, in this context, the effects on global climate change of the overall contribution of all combined Cambo emissions have been assessed as being 'Minor adverse'

and in line with the measures necessary to achieve the UK's, as well as the global, trajectory towards net zero and therefore can be considered to be not significant.

All other impacts identified in the ES covering the drilling, installation and production phases of the Cambo field development are expected to only have localised impacts with good recovery potential over time.

Overall, no environmental impacts have been identified during the environmental impact assessment process that would result in significant risk to the environment which prevents Ithaca Energy from seeking consent for the proposed Cambo field development.

16. References

AEA, 2007. Climate change consequences of VOC emission controls. A report by AEA Energy and Environment for The Department for Environment, Food and Rural Affairs, Welsh Assembly Government, the Scottish Executive and the Department of the Environment for Northern Ireland. AEAT/ENV/R/2475 - Issue 3.

AFEN (2000). Atlantic margin environmental surveys of the seafloor 1996 and 1998. *Atlantic Frontier Environmental Network report on CD-ROM*.

Aichinger Dias, L., Litz, J., Garrison, L., Martinez, A., Barry, K., & Speakman, T. (2017). Exposure of cetaceans to petroleum products following the Deepwater Horizon oil spill in the Gulf of Mexico. *Endangered Species Research*, *33*, 119–125. https://doi.org/10.3354/esr00770

Alonso-Alvarez, C., Pérez, C., & Velando, A. (2007). Effects of acute exposure to heavy fuel oil from the Prestige spill on a seabird. *Aquatic Toxicology*, *84*(1), 103–110. https://doi.org/10.1016/j.aquatox.2007.06.004

Al-Yamani, F.Y., Skryabin, V. & Durvasula, S.R.V., (2015). Suspected ballast water introductions in the Arabian Gulf. *Aquatic Ecosystem Health and Management, 18*(3), 282–289. https://www.tandfonline.com/doi/abs/10.1080/14634988.2015.1027135?journalCode=uaem20

AMS (1952). Army map service special sheet: Iceland. Forth Edition. AMS 1301.

Anatec (2018). Fishing vessel log Sheet Cambo E operation, Spring 2018. A report by Anatec Ltd on behalf of Siccar Point Energy Limited.

Anatec (2025). *Vessel Traffic Survey Cambo E (Block 204/10) (Technical Note).* A study by Anatec Ltd on behalf of Ithaca Energy, 5 August 2025. Ref A5489-ICA-VTS-1.

Andrew, R. K., Howe, B. M., Mercer, J. A., & Dzieciuch, M. A. (2002). Ocean ambient sound: Comparing the 1960s with the 1990s for a receiver off the California coast. *Acoustics Research Letters Online, 3*(2), 65–70. https://doi.org/10.1121/1.1461915

Andrews, N., Bennett, N. J., Billon, P. L., Green, S. J., Cisneros-Montemayor, A. M., Amongin, S., Gray, N. J., & Sumaila, U. R. (2021). Oil, fisheries and coastal communities: A review of impacts on the environment, livelihoods, space and governance. *Energy Research and Social Science*, *75*, 102009. https://doi.org/10.1016/j.erss.2021.102009

Austin, M. E., Hannay, D. E., & Bröker, K. C. (2018). Acoustic characterization of exploration drilling in the Chukchi and Beaufort seas. *The Journal of the Acoustical Society of America, 144*(1), 115–123. https://doi.org/10.1121/1.5044417

Bakke, T., Klungsøyr, J. & Sanni, S., (2013). Environmental impacts of produced water and drilling waste discharges from the Norwegian offshore petroleum industry. *Marine Environmental Research*, *92*, 154-169. https://doi.org/10.1016/j.marenvres.2013.09.012

Barne, J. H., Robson, C. F., Kaznowska, S. S., Doody, J. P., Davidson, N. C., & Buck, A. L. (1997). Coasts and seas of the United Kingdom. Region 2: Orkney. *Joint Nature Conservation Committee*. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-02.pdf

Barnes, M.K.S. (2008). *Nephasoma (Nephasoma) rimicola* A peanut worm. *In*: Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. https://www.marlin.ac.uk/species/detail/120. https://www.marlin.ac.uk/species/detail/120. Accessed June 2025

Barnes, R. S. K. & Bamber, R. N. (1997). Coastal lagoons. *In: Coasts and seas of the United Kingdom. Region 1 Shetland* (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody, N. C. Davidson & A. L. Buck). *Joint Nature Conservation Committee*, 48-50. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-01.pdf

Barreto, E., Bailey, N., Mclay, A., Mesquita, C., Dobby, H. & Blackadder, L. (2016). Fish and Shellfish Stocks 2016. *Marine Scotland Science*. https://webarchive.nrscotland.gov.uk/3000/https://www.gov.scot/Resource/0050/00500638.pdf

Barreto, E., Bailey, N., Mclay, A., Mesquita, C. & Dobby, H. (2017). Fish and Shellfish Stocks 2017 Edition. *Marine Scotland Science*. https://webarchive.nrscotland.gov.uk/20200114141316/http://www.gov.scot/Topics/marine/Publications/publicationslatest/farmedfish/fishandshellfishstocks/2017

Basan, F., Fischer, J., Putland, R., Brinkkemper, J., De Jong, C., Binnerts, B., Norro, A., Kühnel, D., Ødegaard, L., Andersson, M., Lalander, E., Tougaard, J., Griffiths, E., Kosecka, M., Edwards, E., Merchant, N., De Jong, K., Robinson, S., Wang, L., & Kinneging, N. (2023). The underwater soundscape of the North Sea. *Marine Pollution Bulletin*, *198*, 115891. https://doi.org/10.1016/j.marpolbul.2023.115891

Bax, N. Williamson, A. Aguero, M. Gonzalez, E. and Greeves, W., 2003. Marine invasive alien species: a threat to global biodiversity. *Marine Policy, 27*, 313-323. https://doi.org/10.1016/S0308-597X(03)00041-1

Bechmann, R.K., Baussant, T., Tandberg, A.H. & Lowe. D. (2006). Clearance rate, growth, histopathology and biomarker responses in mussels and scallops exposed to suspended particles of water based drilling mud. In: *Impacts of drilling mud discharges on water column organisms and filter feeding bivalves*. (R.K. Bechmann, S. Westerlund, T. Baussant, I.C. Taban, D.M., Pampanin, M. Smith and D. Lowe (eds.)). Report No. 2006/038, IRIS, pp. 39–64.

Department for Business, Energy & Industrial Strategy (BEIS). (2018). *Methodology for the Sampling and Analysis of Produced Water and Other Hydrocarbon Discharges*. https://assets.publishing.service.gov.uk/media/5b2273f740f0b634b1266ce7/Methodology_for

_the_Sampling_and_Analysis_of_Produced_Water_and_Other_Hydrocarbon_Discharges_version_3.pdf

Department for Business, Energy & Industrial Strategy (BEIS). (2022a). UK Offshore Energy Strategic Environmental Assessment 4 (OESEA4). *Department for Business, Energy & Industrial Strategy*. https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-4-oesea4. Accessed June 2025.

Department for Business, Energy & Industrial Strategy (BEIS) (2022b). Guidance Notes for Preparing Oil Pollution Emergency Plans: For Offshore Oil and Gas Installations and Relevant Oil Handling Facilities. https://assets.publishing.service.gov.uk/media/62a9992ad3bf7f036cb7a22e/OPEP_Guidance_-_Rev_7_-_June_2022.pdf. Accessed July 2025.

BEIS/HSE (Undated). *Appendix C – Safety and environmental issues seaward area production licences.* OSD Licensing Operatorship Safety Environmental Aspects

Bellas, J., Saco-Álvarez, L., Nieto, Ó., Bayona, J. M., Albaigés, J., & Beiras, R. (2013). Evaluation of artificially-weathered standard fuel oil toxicity by marine invertebrate embryogenesis bioassays. *Chemosphere, 90*(3), 1103-1108. https://doi.org/10.1016/j.chemosphere.2012.09.015

Department for Business, Enterprise and Regulatory Reform (BERR) 2008, Review of cabling techniques and environmental effects applicable to the offshore wind farm industry. *Technical Report, January 2008*.

Berx, B. (2012). The hydrography and circulation of the Faroe-Shetland Channel, a century of research. *Ocean Challenge, 19*. https://blogs.gov.scot/marine-scotland/wp-content/uploads/sites/23/2014/09/berxb2012_final9_Faroe.pdf. Accessed June 2025

Bett, B. J. & Rice, A. L. (1992). The influence of hexactinellid sponge (*Pheronema carpenteri*) spicules on the patchy distribution of macrobenthos in the Porcupine Seabight (bathyal NE Atlantic). *Ophelia, 36*, 217–226.

Bett, B.J. (2000). Benthic ecology of the UK Atlantic Margin. In: *SOC (2000), White Zone DTI marine surveys 1999*. Preliminary Report, Southampton Oceanography Centre, January 2000.

Bett, B.J. (2003). An introduction to the benthic ecology of the Faroe-Shetland Channel (SEA4). *Technical report prepared for SEA 4 on behalf of the DTI by the DEEPSEAS Group, George Deacon Division, Southampton Oceanography Centre*. https://assets.publishing.service.gov.uk/media/5a7a05fce5274a34770e3b2c/SEA4_TR_Benthos_SOC.pdf.

BirdLife International (2025). *BirdLife International website*. https://datazone.birdlife.org/country/factsheet/faroe-islands. Accessed June 2025.

Blanchard, A., Hauge, K.H., Andersen, G., Fosså, J.H., Grøsvik, B.E., Handegard, N.O., Kaiser, M., Meier, S., Olsen, E. & Vikebø, F. (2013). Harmful routines? Uncertainty in science and conflicting views on routine petroleum operations in Norway. *Marine Policy*, *43*, 313-320.

Bloch. D., Mikkelsen, B. & Ofstad, L.H. (2000). Marine mammals in Faroese waters, with special attention to the south-southeastern sector of the region. *Faroese Fisheries Laboratory and Museum of Natural History, Tórshavn*.

Bopp, L., Resplandy, L., Orr, J. C., Doney, S. C., Dunne, J. P., Gehlen, M., Halloran, P., Heinze, C., Ilyina, T., Séférian, R., Tjiputra, J., & Vichi, M. (2013). Multiple stressors of ocean ecosystems in the 21st century: projections with CMIP5 models. *Biogeosciences, 10*(10), 6225–6245. https://doi.org/10.5194/bg-10-6225-2013

Boyd, S., Limpenny, D., Rees, H., & Cooper, K. (2005). The effects of marine sand and gravel extraction on the macrobenthos at a commercial dredging site (results 6 years post-dredging). *ICES Journal of Marine Science, 62*(2), 145–162. https://doi.org/10.1016/j.icesjms.2004.11.014

Bricheno, L.M., Woolf, D., Valiente, N.G., Makrygianni, N., Chowdhury, P., & Timmermans, B. (2025). Climate change impacts on storms and waves relevant to the UK and Ireland. *MCCIP Science Review 2025*.

British Geological Survey (BGS) (1996). Geology and physical environment. In: *Coasts and seas of the United Kingdom. Region 3 North-east Scotland* (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody & N. C. Davidson). Joint Nature Conservation Committee. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-03.pdf

Bromley, R.G. (2012). *Trace Fossils: Biology, Taxonomy and Applications: Routledge*

Buskey, E. J., White, H. K. & Esbaugh, A. J. (2016). Impact of oil spills on marine life in the Gulf of Mexico: Effects on plankton, nekton, and deep-sea benthos. *Oceanography 29*(3),174–181. https://doi.org/10.5670/oceanog.2016.81

Byrne, M. P., & O'Gorman, P. A. (2018). Trends in continental temperature and humidity directly linked to ocean warming. *Proceedings of the National Academy of Sciences, 115*(19), 4863–4868. https://doi.org/10.1073/pnas.1722312115

Canadell, J.G., Monteiro, P.M.S., Costa, M.H., Cotrim da Cunha, L., Cox, P.M., Eliseev, A.V., Henson, S., Ishii, M., Jaccard, S., Koven, C., Lohila, A., Patra, P.K., Piao, S., Rogelj, J., Syampungani, S., Zaehle, S. & Zickfeld, K. (2021). Global Carbon and other Biogeochemical Cycles and Feedbacks. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge,

United Kingdom and New York, NY, USA, pp. 673–816, https://doi.org/10.1017/9781009157896.007.

Carpenter, A. (2019). Oil pollution in the North Sea: the impact of governance measures on oil pollution over several decades. *Hydrobiologia*, *845*(1), 109–127. https://doi.org/10.1007/s10750-018-3559-2

Carter, M. I. D, Bivins, M., Duck, C. D., HasKe, G. D., Morris, C. D., Moss, S. E. W., Thompson, D., Thompson, P. M., Vincent, C., & Russell, D. J. F. (2025) Updated habitat-based at-sea distribution maps for harbour and grey seals in Scotland. *Sea Mammal Research Unit, University of St Andrews, Commissioned Report to Scottish Government*. https://doi.org/10.7489/12534-1

Castellote, M., Clark, C. W., & Lammers, M. O. (2012). Acoustic and behavioural changes by fin whales (Balaenoptera physalus) in response to shipping and airgun noise. B*iological Conservation, 147*(1), 115–122. https://doi.org/10.1016/j.biocon.2011.12.021

CEFAS (2010). *Blue Whiting Nursery Grounds*. http://cefas.defra.gov.uk/our-science/fisheries-information/ecologically-important-fish-habitats/distribution-of-spawning-and-nursery-grounds.aspx. Accessed June 2025.

Certain, G., Jørgensen, L. L., Christel, I., Planque, B. & Bretagnolle, V. (2015). Mapping the vulnerability of animal community to pressure in marine systems: disentangling pressure types and integrating their impact from the individual to the community level. *ICES Journal of Marine Science, 72*(5), 1470-1482. https://doi.org/10.1093/icesjms/fsv003

Chan, S. C., Kendon, E. J., Roberts, N. M., Fowler, H. J., & Blenkinsop, S. (2016). The characteristics of summer sub-hourly rainfall over the southern UK in a high-resolution convective permitting model. *Environmental Research Letters, 11*(9), 094024. https://doi.org/10.1088/1748-9326/11/9/094024

Charif, R. A. & Clark, C. W. (2009). Acoustic monitoring of large whales in deep waters north and west of the British Isles: 1996 - 2005. *Preliminary Report to the UK Department of Energy and Climate Change, 40pp.*

Claireaux, G., Quéau, P., Marras, S., Le Floch, S., Farrell, A. P., Nicolas-Kopec, A., Lemaire, P. & Domenici, P. (2018). Avoidance threshold to oil water-soluble fraction by a juvenile marine teleost fish. *Environmental Toxicology Chemistry, 37*(3), 854-859. https://doi.org/10.1002/etc.4019

Clark, R. (2001). *Marine pollution* (5th ed.). Oxford University Press.

Climate Change Committee (CCC). (2025). *The Seventh Carbon Budget – Advice for the UK Government, 26 February 2025.* https://www.theccc.org.uk/publication/the-seventh-carbon-budget/

Climate Data Canada (2025). Understanding Shared Socio-economic Pathways (SSPs). *Climate Data Canada website*. https://climatedata.ca/resource/understanding-shared-socio-economic-pathways-ssps/. Accessed October 2025.

Collins, M. D. (1993a). A split-step Padé solution for the parabolic equation method. *The Journal of the Acoustical Society of America, 93*(4), 1736–1742. https://doi.org/10.1121/1.406739

Collins, M. D. (1993b). An energy-conserving parabolic equation for elastic media. The *Journal of the Acoustical Society of America, 94*(2), 975–982. https://doi.org/10.1121/1.408199

Collins, S. B., Tweddle, J. F. & Shucksmith, R. J. (2015). Rapid assessment of marine non-native species in the Shetland Islands, Scotland. *Bioinvasions Records*, *4*(3), 147-155.

Cooper, K., Boyd, S., Eggleton, J., Limpenny, D.F., Rees, H. & Vanstaen, K. (2007). Recovery of the seabed following marine aggregate dredging on the Hastings Shingle Bank off the south coast of England. *Estuarine, Coastal and Shelf Science, 75*, 547-558.

Cordes, E. E., Jones, D. O. B., Schlacher, T. A., Amon, D. J., Bernardino, A. F., Brooke, S., Carney, R., DeLeo, D. M., Dunlop, K. M., Escobar-Briones, E. G., Gates, A. R., Génio, L., Gobin, J., Henry, L., Herrera, S., Hoyt, S., Joye, M., Kark, S., Mestre, N. C., Metaxas, A., Pfeifer, S., Sink, K., Sweetman, A. K. & Witte, U. (2016). Environmental Impacts of the Deep-Water Oil and Gas Industry: A review to guide management strategies. *Frontiers in Environmental Science, 4*. https://doi.org/10.3389/fenvs.2016.00058.

Costa, M., Erzini, K. & Borges, T. (2005). Reproductive biology of the blackmouth catshark, *Galeus melastomus* (Chondrichthyes: Scyliorhinidae) off the south coast of Portugal. *Journal of the Marine Biological Association of the United Kingdom, 85*(5). 1173 - 1183. https://doi.org/10.1017/s0025315405012270.

Coull, K. A., Johnstone, R. & Rogers, S. I. (1998). *Fisheries sensitivity maps in British Waters*. UKOOA Limited, Aberdeen.

Cranford, P. L., Gordon, D. C., Lee, K., Armsworthy, S. L & Tremblay, G. H. (1999). Chronic toxicity and physical disturbance effects of water- and oil-based drilling fluids and some major constituents on adult sea scallops (*Placopecten magellanicus*). *Marine Environmental Research, 48*, 225-256.

Crown Estate Scotland (CES) (2025). *Crown Estate Scotland Spatial Hub*. https://crown-estate-scotland-spatial-hub-coregis.hub.arcgis.com/. Accessed June 2025.

Currie, D. R., & Isaacs, L. R. (2005). Impact of exploratory offshore drilling on benthic communities in the Minerva gas field, Port Campbell, Australia. *Marine Environmental Research*, *59*(3), 217–233. https://doi.org/10.1016/j.marenvres.2004.05.001

Dachev, Y. (2022). Oil spills weathering. *Annals of Reviews & Research*, *8*(1). https://doi.org/10.19080/arr.2022.08.555730

Dargie, T. C. D. (1996). Cliffs and cliff-top vegetation. In: *Coasts and seas of the United Kingdom. Region 3 North-east Scotland* (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody, N. C. Davidson & A. L. Buck)). Joint Nature Conservation Committee. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-03.pdf

Dargie, T. C. D. (1997). Cliffs and cliff-top vegetation. In: *Coasts and Seas of the United Kingdom. Region 1 Shetland*. Joint Nature Conservation Committee. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-01.pdf

Davis, R. A., Richardson, W. J., Theile, L., Dietz, R. & Johansen, P. (1990). *State of the Arctic: Environment Report on Underwater Noise*. Finnish initiative on protection of the Arctic environment.

De-Bastos, E.S.R. (2016). *Paramphinome jeffreysii*, *Thyasira spp*. and *Amphiura filiformis* in offshore circalittoral sandy mud. In *Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth: Marine Biological Association of the United Kingdom. https://www.marlin.ac.uk/habitat/detail/1109. Accessed June 2025.

Debes, H. H. (2000). Plankton in the Faroe-Shetland Channel: a review. *The Faroese Fisheries Laboratory*.

DeepOcean (2025). Cambo Well Inspection and Environmental Report. Report to Ithaca Energy. Ref. PRJ002146-DO-INS-OBS-0002. Dated 7 April 2025.

de Lima Silva, F. J., Attademo, F. L. N., Gavilan, S. A., Rossi, S., De Farias, D. S. D., Da Costa Bomfim, A., De Oliveira, R. M., Fragoso, A. B. L., Corrêa, G. C., Santoro, G. A., Ambrósio, G. M. L., Lima, M. A., Lima, S. A., & De Oliveira, R. E. M. (2023). Overview of oil spills worldwide and impacts on marine megafauna. *Brazilian Journal of Case Reports*, *4*(1), 78–94. https://doi.org/10.52600/2763-583x.bjcr.2024.4.1.78-94.

Department of Energy and Climate Change (DECC) (2004). *Strategic Environmental Assessment 5 (SEA 5). ECOLOGY.* https://assets.publishing.service.gov.uk/media/5a74b3cbed915d502d6ca485/SEA5_Section_6.pdf. Accessed June 2025

Department of Energy and Climate Change (DECC) (2014a). *DECC Guidance and Reporting Requirements. Environmental Management System Requirements in relation to OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry.* OSPAR 2003/5 DECC Guidance: Revised Issue 5: May 2014

Department of Energy and Climate Change (DECC) (2014b). *The United Kingdom Risk Based Approach Implementation Programme, Version 2*. United Kingdom Department of Energy and Climate Change.

Department of Energy and Climate Change (DECC) (2016). *UK Offshore Energy Strategic Environmental Assessment 3 (OESEA 3)*. Department of Energy and Climate Change. https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-3-oesea3. Accessed June 2025

Department for Energy Security and Net Zero (DESNZ) (2024a). *Provisional UK greenhouse gas emissions national statistics 2023*. https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2023. Accessed October 2025.

Department for Energy Security and Net Zero (DESNZ) (2024b). *Final UK greenhouse gas emissions national statistics: 1990 to 2022*. https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2022. Accessed October 2025.

Department for Energy Security and Net Zero (DESNZ) (2025). *Environmental Data*. https://itportal.energysecurity.gov.uk/eng/fox. Accessed September 2025.

DNV (2022). *Environmental baseline report, Rosebank Gas Export Pipeline Route*. Report No. 2022-0766, Rev. 0.

Department of Trade and Industry (DTI) (2000). Strategic Environmental Assessment of the Former White Zone. Volume 2 – Synthesis of Environmental Information. *Consultation document prepared for the Department of trade and Industry by Hartley Anderson Ltd*. https://assets.publishing.service.gov.uk/media/5a7c5871e5274a1b00423275/SEA1_Volume_2.pdf. Accessed June 2025

Department of Trade and Industry (DTI) (2001). *Strategic Environmental Assessment of the Mature Areas of the Offshore North Sea – SEA2*. Report to the Department of Trade and Industry.

Department of Trade and Industry (DTI) (2003). *4th Strategic Environmental Assessment: area north and west of Orkney and Shetland*. Consultation document. Department of Trade and Industry.

Department of Trade and Industry (DTI) (2007). *Strategic Environmental Assessment (SEA) 7 Environmental Report*. Department of Trade and Industry.

Duck, C. D. (2007). Seals – Naturally Scottish. *Scottish Natural Heritage Trends Notes Series*.

Dulvy, N. K., Rogers, S. I., Jennings, S., Stelzenmüller, V., Dye, S. R., & Skjoldal, H. R. (2008). Climate change and deepening of the North Sea fish assemblage: a biotic indicator of warming seas. *Journal of Applied Ecology*, *45*(4), 1029–1039. https://doi.org/10.1111/j.1365-2664.2008.01488.x

Ebert, D. A., & Stehmann, M. F. (2013). Sharks, batoids and chimaeras of the North Atlantic. *FAO Species Catalogue for Fishery Purposes. No. 7,* 523.

Edwards, R., & White, I. (1999). The Sea Empress Oil Spill: Environmental impact and recovery. *International Oil Spill Conference Proceedings*, *1999*(1), 97–102. https://doi.org/10.7901/2169-3358-1999-1-97

Ehlert, D., & Zickfeld, K. (2018). Irreversible ocean thermal expansion under carbon dioxide removal. *Earth System Dynamics, 9*(1), 197–210. https://doi.org/10.5194/esd-9-197-2018

Ellis, J. R., Milligan, S.P., Readdy, L., South, A., Taylor, N. & Brown, M. (2010). *Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones).* Report No 1: Final Report on development of derived data layers for 40 mobile species considered to be of conservation importance. Cefas, Lowestoft

Ellis, J. R., Milligan, S. P., Readdy, L., Taylor, N., & Brown, M. J. (2012). *Spawning and nursery grounds of selected fish species in UK waters*. Science Series Technical Report, No 147. Cefas, Lowestoft. https://www.cefas.co.uk/publications/techrep/techrep147.pdf

English, P. A., Mason, T. I., Backstrom, J. T., Tibbles, B. J., Mackay, A. A., Smith, M. J. & Mitchell, T. (2017). Improving efficiencies of National Environmental Policy Act documentation for offshore wind facilities case studies report. *US Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling. OCS Study BOEM 2017-026. pp. 217.*

ENIprogetti (2026). Cambo Development Project, Basic design, FPSO, *FPSO General GHG Emissions*. Project code: PRJ-GB-2025-0001. Company Document ID: 108100BFRV09505. Rev 06, 26/01/2026.

Erbe, C., McCauley, R., McPherson, C., & Gavrilov, A. (2013). Underwater noise from offshore oil production vessels. *The Journal of the Acoustical Society of America, 133*(6), EL465–EL470. https://doi.org/10.1121/1.4802183

European Environment Agency (EEA) (2019a). Grey seal - *Halichoerus grypus* (Fabricius, 1791). https://eunis.eea.europa.eu/species/1421. Accessed June 2025

European Environment Agency (EEA) (2019b). Common seal - *Phoca vitulina* Linnaeus, 1758. https://eunis.eea.europa.eu/species/1507. Accessed June 2025

European Marine and Observation Data Network (EMODnet) (2025). *EMODnet Map Viewer*. https://emodnet.ec.europa.eu/geoviewer/. Accessed June 2025.

Engås, A., Løkkeborg, S., Ona, E., & Soldal, A. V. (1996). Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). *Canadian Journal of Fisheries and Aquatic Sciences, 53*(10), 2238–2249. https://doi.org/10.1139/f96-177

Engås, A., & Løkkeborg, S. (2002). Effects of Seismic Shooting and Vessel-Generated Noise on Fish Behavioys and Catch Rates. *Bioacoustics, 12*(2–3), 313–316. https://doi.org/10.1080/09524622.2002.9753733

Evans, P. & Harvey, P. (2019). *Whales and dolphins*. https://www.nature-shetland.co.uk/whales-dolphins. Accessed June 2025

Evans, P. G. H. & Nice, H. (1996). *Review of the effects of underwater sound generated by seismic surveys on cetaceans.* Sea Watch Foundation, Oxford.

Evans, P. G. H. (1998). *Biology of cetaceans of the North-east Atlantic (in relation to seismic energy).* Seismic and marine mammals workshop, London, 23 to 25 June 1998.

FeAST (2025).*FeAST website*. https://feature-activity-sensitivity-tool.scot/. Accessed November 2025

Findlay, M., Alexander, L. & Macleod, C. (2015). Site condition monitoring for otters (*Lutra lutra*) in 2011-12. *Scottish Natural Heritage Commissioned Report No. 521*.

Fontes, C. G., Dawson, T. E., Jardine, K., McDowell, N., Gimenez, B. O., Anderegg, L., Negrón-Juárez, R., Higuchi, N., Fine, P. V. A., Araújo, A. C., & Chambers, J. Q. (2018). Dry and hot: the hydraulic consequences of a climate change–type drought for Amazonian trees. *Philosophical Transactions of the Royal Society B Biological Sciences, 373*(1760), 20180209. https://doi.org/10.1098/rstb.2018.0209

Foote, K. G. (2014). Discriminating between the nearfield and the farfield of acoustic transducers. *J. Acoust. Soc. Am., 136*(4), 1511–1517. https://doi.org/10.1121/1.4895701

Fowler, S., Mogensen, C. B. & Blasdale, T. (2004). *Plan of Action for the Conservation and Management of Sharks in UK Waters.* https://data.jncc.gov.uk/data/1db13bd9-ead2-4b22-a965-99de5de1c457/JNCC-Report-360-FINAL-WEB.pdf. Accessed June 2025

Fox-Kemper, B., Hewitt, H.T., Xiao, C., Aðalgeirsdóttir, G., Drijfhout, S.S., Edwards, T.L., Golledge, N.R., Hemer, M., Kopp, R.E., Krinner, G., Mix, A., Notz, D., Nowicki, S., Nurhati, I.S., Ruiz, L., Sallée, J.-B., Slangen, A.B.A. & Yu, Y. (2021). Ocean, Cryosphere and Sea Level Change. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1211–1362, doi:10.1017/9781009157896.011.

Frankish, C. K., Von Benda-Beckmann, A. M., Teilmann, J., Tougaard, J., Dietz, R., Sveegaard, S., Binnerts, B., De Jong, C. A., & Nabe-Nielsen, J. (2023). Ship noise causes tagged harbour porpoises to change direction or dive deeper. *Marine Pollution Bulletin*, *197*, 115755. https://doi.org/10.1016/j.marpolbul.2023.115755

Frasier, K. E., Solsona-Berga, A., Stokes, L., & Hildebrand, J. A. (2019). Impacts of the Deepwater Horizon Oil Spill on Marine Mammals and Sea Turtles. *Deep Oil Spills*, 431–462. https://doi.org/10.1007/978-3-030-11605-7_26

Frisk, G. V. (2012). Noiseonomics: The relationship between ambient noise levels in the sea and global economic trends. *Scientific Reports, 2*(1), 437. https://doi.org/10.1038/srep00437

Fugro (2011a). *Cambo environmental survey UKCS Block 204/05*. Fugro Survey Ltd Report No 00650V2.0.

Fugro (2011b). *Cambo 4 pre- and post-drill habitat assessment*. Fugro GeoConsulting ERT Report Number: J36124.

Fugro (2013). *Cambo 5 Pre- and post-drill habitat assessment UKCS Block 204/5*. Fugro EMU Limited Report No. J/1/20/2273.

Fugro (2017). *Habitat assessment of proposed well 204/10a-E UKCS Block 204/10a*. Fugro Document Number: 179260.01_Rev02.Fugro.

Fugro (2018). *Scoping Study – Cambo Field Phase 1 Development*. A report prepared on behalf of Siccar Point Energy E&P Limited. Fugro Document Number: 172865-R-002(03).

Fugro (2024). *Tornado Site Survey and Route Survey from Tornado to Tormore UKCS Blocks 204/13 to 205/5a. Marine Mammal Mitigation Report*. Report No: F248567-REP-012 02

Fugro (2025a). *Cambo Route Survey Habitat Assessment Report*. Report No: F271379-REP-006 01

Fugro (2025b). *Fugro Metocean Planner*. 10-year climate data. Lat:61.0, Long: -4.5.

Fugro (2025c). *Oil spill database*. Database comprising statistics collated from DESNZ (formerly DTI, BERR, DECC, and BEIS) from 1990 to 2024. Fugro GB Marine Limited.

Fugro (2025d). *Environmental Baseline Survey Cambo Route Survey*. Report No: F271379-REP-005 01.

Fugro (2025e). *Tornado Site Survey and Route Survey from Tornado to Tormore UKCS Quads 204 to 205. Volume 9 of 10: Tornado Site Habitat Assessment Report*. Report No: F248567-REP-009 02.

Fugro (2025f). *Tornado Site Survey and Route Survey from Tornado to Tormore UKCS Quads 204 to 205. Volume 8 of 10: Tornado to Tormore Route Environmental Baseline Survey Report*. Report No: F248567-REP-008 02.

Fugro (2025g). *Cambo Produced Water Modelling*. Report No: 278823-PW

Fugro (2025h). *Cambo Drill Cuttings Dispersion Modelling*. Report to Ithaca Energy (UK) Limited. Reference 278823 03.

Fugro (2025i). *Cambo Field Development Environmental Desk Top Study*. Report No: 505283-001 03

Fugro (2025j). *Environmental Impact Assessment Procedure*. UK-ECO-CDD-PR-001. Issue 2, 16 July 2025

Gagnon, M. M. (2011). Evidence of Exposure of Fish to Produced Water at Three Offshore Facilities, North West Shelf, Australia. In: Lee, K., Neff, J. (eds) *Produced Water*. Springer, New York, NY. https://doi.org/10.1007/978-1-4614-0046-2_15

Galindo-Romero, M., Lippert, T., & Gavrilov, A. (2015). Empirical prediction of peak pressure levels in anthropogenic impulsive noise. Part I: Airgun arrays signals. *The Journal of the Acoustical Society of America, 138*(6), EL540–EL544. https://doi.org/10.1121/1.4938269

Gardline (2001). *Environmental baseline survey of the UKCS 204/10*. August to October 2001. Gardline project ref 5694.

Gariano, S. L., & Guzzetti, F. (2016). Landslides in a changing climate. *Earth-Science Reviews, 162*, 227–252. https://doi.org/10.1016/j.earscirev.2016.08.011

Gattuso, J., Magnan, A., Billé, R., Cheung, W. W. L., Howes, E. L., Joos, F., Allemand, D., Bopp, L., Cooley, S. R., Eakin, C. M., Hoegh-Guldberg, O., Kelly, R. P., Pörtner, H., Rogers, A. D., Baxter, J. M., Laffoley, D., Osborn, D., Rankovic, A., Rochette, J., … Turley, C. (2015). Contrasting futures for ocean and society from different anthropogenic CO_2 emissions scenarios. *Science, 349*(6243). https://doi.org/10.1126/science.aac4722

Gilles, A., Authier, M., Ramirez-Martinez, N.C., Araújo, H., Blanchard, A., Carlström, J., Eira, C., Dorémus, G., Fernández-Maldonado, C., Geelhoed, S. C. V., Kyhn, L., Laran, S., Nachtsheim, D., Panigada, S., Pigeault, R., Sequeira, M., Sveegaard, S., Taylor, N. L., Owen, K., Saavedra, C., Vázquez-Bonales, J.A., Unger, B., Hammond, P.S. (2023). Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys (Final Report). https://tinyurl.com/3ynt6swa. Accessed June2025

Gordon, J. D. M. & Hunter, J. E. (1994). Study of the deep-water fish stocks to the west of Scotland. *Scottish Association for Marine Science.*

Gordon, J. D. M. & Swan, S. C. (1997). The distribution and abundance of deep-water sharks on the continental slope to the west of the British Isles. *ICES CM 1997/BB*, 11-23.

Gordon, J. C. D., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M. P., Swift, R. & Thompson, D. (2003). A review of the effects of seismic surveys on marine mammals. *Marine Technology Society Journal, 37*(4), pp. 14-32. https://doi.org/10.4031/002533203787536998

Gormley, A., Pollard, S. & Rocks, S (2011). Guidelines for Environmental Risk Assessment and Management: Green Leaves III. *Department for Environment, Food and Rural Affairs (Defra).* https://www.gov.uk/government/publications/guidelines-for-environmental-risk-assessment-and-management-green-leaves-iii

Gray, J. S., Clarke, A. J., Warwick, R. M., & Hobbs, G. (1990). Detection of initial effects of pollution on marine benthos: an example from the Ekofisk and Eldfisk oilfields, North Sea. *Marine Ecology Progress Series*, *66*(3), 285–299. http://dx.doi.org/10.3354/meps066285

Green, R. & Green, J. (1997). Otter survey of Scotland 1991 to 1994. *Published by the Vincent Wildlife Trust.*

GHG Protocol (2015). The Greenhouse Gas Protocol. https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf. Accessed November 2015

Gruber, N., Clement, D., Carter, B. R., Feely, R. A., Van Heuven, S., Hoppema, M., Ishii, M., Key, R. M., Kozyr, A., Lauvset, S. K., Lo Monaco, C., Mathis, J. T., Murata, A., Olsen, A., Perez, F. F., Sabine, C. L., Tanhua, T., & Wanninkhof, R. (2019). The oceanic sink for anthropogenic CO_2 from 1994 to 2007. *Science, 363*(6432), 1193–1199. https://doi.org/10.1126/science.aau5153

Gulev, S.K., Thorne, P.W., Ahn, J., Dentener, F.J., Domingues, C.M., Gerland, S., Gong, D., Kaufman, D.S., Nnamchi, H.C., Quaas, J., Rivera, J.A., Sathyendranath, S., Smith, S.L., Trewin, B., von Schuckmann, K. & Vose, R.S. (2021). Changing State of the Climate System. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 287–422. https://doi.org/10.1017/9781009157896.004.

Gunton, L. M., Neal, L., Gooday, A. J., Bett, B. J., & Glover, A. G. (2015). Benthic polychaete diversity patterns and community structure in the Whittard Canyon system and adjacent slope (NE Atlantic). *Deep Sea Research Part I Oceanographic Research Papers, 106*, 42–54. https://doi.org/10.1016/j.dsr.2015.07.004

Hammill, M. O., Lydersen, C., Kovacs, K. M. & Sjare, B. (1997). Estimated fish consumption by hooded seals (Cystophora cristata) in the Gulf of St. Lawrence. *Journal of Northwest Atlantic Fish Science*, *22,* 249-257.

Hammond, P. S., Gordon, J. C. D., Grellier, K., Hall, A. J., Northridge, S. P., Thompson, D. & Harwood, J. (2001). Background information on marine mammals relevant to strategic environmental assessment 2. *Sea Mammal Research Unit, Gatty Marine Laboratory, University of St Andrews*.

Hammond, P.S., Macleod, S.P., Northridge, D., Thompson, D. & Mattiopoulos, J. (2003). Background information on marine mammals relevant to strategic environmental assessment 4. Sea Mammal Research Unit, Gatty Marine Laboratory, University of St Andrews.

Hammond, P. S., Northridge, S. P., Thompson, D., Gordon, J. C. D., Hall, A. J., Duck, C. D., Aarts, G., Cunningham, L., Embling, C. B. & Matthiopoulos, J. (2006). Background information on

marine mammals for Strategic Environmental Assessment 7. *Report to the DTI from Sea Mammal Research Unit, University of St. Andrews, UK, 63pp. plus appendices.*

Hammond, P. S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M. B., Scheidat, M., Teilmann, J., Vingada, J. & Øien, N., (2021). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. SCANS-III project report. https://scans3.wp.st-andrews.ac.uk/files/2021/06/SCANS-III_design-based_estimates_final_report_revised_June_2021.pdf. Accessed June 2025.

Hamoutene, D., Volkoff, H., Parrish, C., Samuelson, S., Mabrouk, G., Mansour, A., Mathieu, A., King, T. & Lee, K. (2011). Effect of Produced Water on Innate Immunity, Feeding and Antioxidant Metabolism in Atlantic Cod (Gadus morhua). In: *Produced water. Environmental risks and advances in mitigation technologies* (K. Lee and J. Neff (eds.)). Springer Science + Business Media, LLC.

Hansen, B., Poulsen, T., Húsgarð Larsen, K. M., Hátún, H., Østerhus, S., Darelius, E., Berx, B., Quadfasel, D., & Jochumsen, K. (2017). Atlantic water flow through the Faroese Channels, *Ocean Science, 13,* 873–888. https://doi.org/10.5194/os-13-873-2017. Accessed June 2025.

Hansen, L. J. & Mortensen, L. E. (2025). Landscapes and coasts on the Faroe Islands. *Trap The Faroe Islands*. https://trap.fo/en/nature-and-landscape/landskaber-pa-faeroerne/. Accessed July 2025.

Harland, E. J., Jones, S. A. S. & Clarke, T. (2005*). SEA 6 technical report: underwater ambient noise* (Report No. QINETIQ/SandE/MAC/CR050575, version 1.2). A report by QinetiQ to Department of Trade and Industry (DTI) for the sixth offshore energy strategic environmental assessment (SEA6) programme. https://assets.publishing.service.gov.uk/media/5a7a3a30ed915d1fb3cd65bd/SEA6_Noise_QinetiQ.pdf.

Hartley Anderson & University of Aberdeen (2003). *Existing users and management initiatives relevant to SEA4*. Report to the Department of Trade and Industry. https://assets.publishing.service.gov.uk/media/5a7a122240f0b66eab999867/SEA4_TR_Users_UOA.pdf. Accessed June 2025.

Hatch, T. & Wright, J. (2007). A brief review of anthropogenic sound in the oceans. *International Journal of Comparative Psychology, 20,* 121–133. https://escholarship.org/uc/item/5cj6s4r9

Hatun, H., Jacobsen, J. A., & Sandø, A. B. (2007). Environmental influence on the spawning distribution and migration pattern of northern blue whiting (*Micromesistius poutassou*). *2007 Annual Science Conference, Helsinki, Finland. CM 2007/B:06.* https://doi.org/10.17895/ices.pub.25257562

Hayes, E., Godley, B. J., Nimak-Wood, M. & Witt, M. J. (2018). *Basking shark breaching behaviour observations west of Shetland*. https://marine.gov.scot/sma/content/basking-shark-breaching-behaviour-observations-west-shetland. Accessed June 2025.

HDR (2018). Benthic monitoring during wind turbine installation and operation at the Block Island wind farm, Rhode Island. *Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2018-047. pp. 155*.

Heath, & Jónasdóttir, S. (1999). Distribution and abundance of overwintering Calanus finmarchicus in the Faroe–Shetland Channel. *Fisheries Oceanography*, *8*(s1), 40–60. https://doi.org/10.1046/j.1365-2419.1999.00012.x

Helm, R. C., Costa, D. P., DeBruyn, T. D., O'Shea, T. J., Wells, R. S., & Williams, T. M. (2015). Overview of Effects of Oil Spills on Marine Mammals. *Handbook of Oil Spill Science and Technology*, 455–475. https://doi.org/10.1002/9781118989982.ch18

Heubeck, M., Camphuysen, K. C., Bao, R., Humple, D., Sandoval Rey, A., Cadiou, B., Bräger, S., & Thomas, T. (2003). Assessing the impact of major oil spills on seabird populations. *Marine Pollution Bulletin*, *46*(7), 900–902. https://doi.org/10.1016/s0025-326x(03)00098-5

Hildebrand, J. (2009). Anthropogenic and natural sources of ambient noise in the ocean. *Marine Ecology Progress Series*, *395*, 5–20. https://doi.org/10.3354/meps08353

Hill, M. I. (1996). Saltmarsh. In: *Coasts and seas of the United Kingdom. Region 3 North-east Scotland: Cape Wrath to St Cyrus.* (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody & N. C. Davidson). *Joint Nature Conservation Committee*. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-03.pdf

Hill, M. I. (1997a). Saltmarsh. In: *Coasts and seas of the United Kingdom. Region 1 Shetland*. (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody & N. C. Davidson). *Joint Nature Conservation Committee*, 54-56. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-01.pdf

Hill, M. I. (1997b). Saltmarsh. In: *Coasts and Seas of the United Kingdom. Region 2 Orkney*. (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody & N. C. Davidson). *Joint Nature Conservation Committee*, 53-55. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-02.pdf

Holling, C. S. (2001). Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems, 4*(5), 390-405. http://dx.doi.org/10.1007/s10021-001-0101-5.

Howson, C. M. (1998). Shetland (MNCR Sector 1). *In:* Marine Nature Conservation Review. Benthic marine ecosystems of Great Britain and the north-east Atlantic. *Joint Nature Conservation Committee*, 73-108. https://data.jncc.gov.uk/data/575d02ea-7f19-440c-9122-66a1747e0fc3/jncc-mncr-benthic-ecosystems-part-2-c1-c2-c3.pdf

HSE (2007). *Accidental statistics for floating offshore units on the UK Continental Shelf, 1980 to 2005.* Research report RR567, Prepared by Det Norske Veritas for the Health and Safety Executive (HSE).

Institute of Environmental Management & Assessment (IEMA) (2022). *Guide to: Assessing greenhouse gas emissions and evaluating their significance*. 2nd edition, February 2022. https://www.iema.net/media/xmgpoopk/2022_iema_greenhouse_gas_guidance_eia.pdf

Institute of Environmental Management and Assessment (IEMA) (2024). *Impact Assessment Guidelines: Implementing the Mitigation Hierarchy from Concept to Construction*. August 2024. https://www.iema.net/media/oone2qce/iema-mitigation-in-eia-guidance-final.pdf

Intergovernmental Panel on Climate Change (IPCC) (2001). *Climate Change 2001: The Scientific Basis.* Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/2018/02/WG1_TAR-FRONT.pdf

Intergovernmental Panel on Climate Change (IPCC) (2007). *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/2018/05/ar4_wg1_full_report-1.pdf

Intergovernmental Panel on Climate Change (IPCC) (2021). *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FullReport.pdf

Intergovernmental Panel on Climate Change (IPCC) (2023). *Climate Change 2023: Synthesis Report*. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

International Council for the Exploration of the Sea (ICES) (2023). *Aquaculture Overview for Faroes ecoregion*. https://www.ices.dk/news-and-events/news-archive/news/Pages/FaroesAO.aspx. Accessed June 2025

International Council for the Exploration of the Sea (ICES) (2025). *Catch Statistics*. https://www.ices.dk/data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx. Accessed October 2025.

International Association of Oil and Gas Producers (IOGP) (2011). *An overview of marine seismic operations* (Report no. 448).

Di Iorio, L., & Clark, C. W. (2009). Exposure to seismic survey alters blue whale acoustic communication. *Biology Letters, 6*(1), 51–54. https://doi.org/10.1098/rsbl.2009.0651

International Petroleum Industry Environmental Conservation Association (IPIECA) (2000). *Biological Impacts of Oil Pollution: Fisheries*. IPIECA Report Series, 8, 32.

International Petroleum Industry Environmental Conservation Association (IPIECA) (2008). *Oil spill preparedness and response: report series summary*. International Petroleum Industry Environmental Conservation Association, 42.

International Petroleum Industry Environmental Conservation Association (IPIECA) (2016). *Impacts of oil spills on shorelines*. International Petroleum Industry Environmental Conservation Association Report, 534.

International Organization for Standardization (ISO) (2017). *Underwater acoustics — Terminology (ISO Standard No. 18405:2017)*. https://www.iso.org/standard/62406.html

International Tanker Owners Pollution Federation Limited (ITOPF) (2014a). *Technical Information Paper 2: Fate of Marine Oil Spills*. ITOPF Limited.

International Tanker Owners Pollution Federation Limited (ITOPF) (2014b). *Technical Information Paper 13: Effects of Oil Pollution on the Marine Environment*. ITOPF Limited.

Irving, R. (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive: Summary report of an inter-agency workshop. *JNCC Report No. 432*. https://doi.org/10.13140/2.1.2278.5283

Irving, R. A. (1997a). The seabed. In: *Coasts and seas of the United Kingdom. Region 1 Shetland* (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody, N. C. Davidson & A. L. Buck). *Joint Nature Conservation Committee*, 58-69. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-01.pdf

Irving, R. A. (1997b). The seabed. In: *Coasts and seas of the United Kingdom. Region 2 Orkney* (J. H. Barne, C. F. Robson, S. S. Kaznowska, J. P. Doody, N. C. Davidson & A. L. Buck). *Joint Nature Conservation Committee*, 60-67. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-02.pdf

Jákupsstovu, S. H (1996). The fisheries in Faroese water: fleets, activities, distribution and potential conflicts of interest with an offshore oil industry. *Fiskirannsóknarsovan (The Fisheries Laboratory of the Faroe Islands)*.

Jalkanen, J., Johansson, L., Andersson, M. H., Majamäki, E., & Sigray, P. (2022). Underwater noise emissions from ships during 2014–2020. *Environmental Pollution, 311*, 119766. https://doi.org/10.1016/j.envpol.2022.119766

Jenkins, K. D., Howe, S., Sanders, B. M & Norwood, C. (1989). Sediment deposition, biological accumulation and subcellular distribution of barium following the drilling of an exploratory well. In: *Proceedings of the 1988 international conference on drilling wastes*. (F.R. Engelhardt, J.P. Ray and A.H. Gillam (eds.)). *Drilling wastes., Calgary, Alberta, Canada, pp. 587-608*.

Jensen, F. B., Kuperman, W. A., Porter, M. B., & Schmidt, H. (2011). Computational ocean acoustics (2nd ed.). *Springer*. https://doi.org/10.1007/978-1-4419-8678-8

Jiang, L., Carter, B. R., Feely, R. A., Lauvset, S. K., & Olsen, A. (2019). Surface ocean pH and buffer capacity: past, present and future. *Scientific Reports, 9*(1). https://doi.org/10.1038/s41598-019-55039-4

Johns, D. & Wootton, M. (2003), Plankton Report for Strategic Environment Assessment Area 4. *Technical report for SEA4*. https://assets.publishing.service.gov.uk/media/5a7ac2dce5274a34770e6f16/SEA4_TR_Plankton_SAHFOS.pdf

Joint Nature Conservation Committee (JNCC) (2010). *The protection of marine European Protected Species from injury and disturbance (Draft). Guidance for the marine area in England and Wales and the UK offshore marine area.* Prepared by Joint Nature Conservation Committee, Natural England and Countryside Council for Wales.

Joint Nature Conservation Committee (JNCC) (2014). *North-east Faroe Shetland channel nature conservation MPA*. https://data.jncc.gov.uk/data/599143aa-d0c8-405c-9665-2973e581cdd0/NEFSC-3-ApplicationMPASelectionGuidelines-v4.0.pdf. Accessed June 2025.

Joint Nature Conservation Committee (JNCC) (2017). *JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys*. Prepared by Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. https://data.jncc.gov.uk/data/e2a46de5-43d4-43f0-b296-c62134397ce4/jncc-guidelines-seismicsurvey-aug2017-web.pdf

Joint Nature Conservation Committee (JNCC) (2020a). Statement on conservation benefits, condition and conservation measures for Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area. *Prepared by Joint Nature Conservation Committee (April 2018).* https://jncc.gov.uk/resources/1422e961-edfb-40e8-b1ad-2eaf67cf21f0

Joint Nature Conservation Committee (JNCC) (2020b). *Ornithology: oil & gas*. https://jncc.gov.uk/our-work/ornithology-oil-gas/. Accessed June 2025.

Joint Nature Conservation Committee (JNCC) (2022). *MPA Mapper*. https://jncc.gov.uk/mpa-mapper/. Accessed June 2025.

Joint Nature Conservation Committee (JNCC) (2025). *Joint Nature Conservation Committee website*. Available at: http://www.jncc.gov.uk. Accessed June 2025.

Jones, D. & Gates, A. (2010). Assessing the effects of hydrocarbon drilling activity on deep-water megafauna in the northern North Atlantic. A rapid universal assessment method? *SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Rio de Janeiro, Brazil, 12 to 14 April 2010.*

Jones, D. O. B., Wigham, B. D., Hudson, I. R., & Bett, B. J. (2007). Anthropogenic disturbance of deep-sea megabenthic assemblages: a study with remotely operated vehicles in the Faroe-Shetland Chanel, NE Atlantic. *Marine Biology, 151*(5), 1731–1741. http://dx.doi.org/10.1007/s00227-007-0606-3

Jones, D. O., Bett, B. J., & Tyler, P. A. (2007). Megabenthic ecology of the deep Faroe–Shetland channel: A photographic study. *Deep Sea Research Part I Oceanographic Research Papers, 54*(7), 1111–1128. https://doi.org/10.1016/j.dsr.2007.04.001

Jones, D., Gates, A., & Lausen, B. (2012). Recovery of deep-water megafaunal assemblages from hydrocarbon drilling disturbance in the Faroe−Shetland Channel. *Marine Ecology Progress Series, 461*, 71–82. https://doi.org/10.3354/meps09827

Jones, E., McConnell, B.J., Sparling, C., & Matthiopoulos, J. (2013). Grey and harbour seal density maps. Marine Mammal Scientific Support Research Programme MMSS/001/11. *Sea Mammal Research Unit Report to Scottish Government.* https://www.smru.st-andrews.ac.uk/files/2015/10/MR5_Seal_density_maps.pdf

Jones, E.I., McConnell, B.J., Smout, S.C., Hammond, P.S., Duck, C.D., Morris, C., Thompson, D., Russell, D.J.F., Vincent, C., Cronin, M., Sharples, R.J. & Matthiopoulos, J. (2015). Patterns of space use in sympatric marine colonial predators revels scales of spatial partitioning. *Marine Ecological Progress Series*, *534*, 235-249. http://dx.doi.org/10.3354/meps11370

Kauppi, L., Norkko, J., Ikonen, J., & Norkko, A. (2017). Seasonal variability in ecosystem functions: quantifying the contribution of invasive species to nutrient cycling in coastal ecosystems. *Marine Ecology Progress Series*, *572*, 193–207. https://doi.org/10.3354/meps12171

Kazanidis, G., Vad, J., Henry, L., Neat, F., Berx, B., Georgoulas, K., & Roberts, J. M. (2019). Distribution of Deep-Sea sponge aggregations in an area of multisectoral activities and changing oceanic conditions. *Frontiers in Marine Science, 6*. https://doi.org/10.3389/fmars.2019.00163

Keramea, P., Spanoudaki, K., Zodiatis, G., Gikas, G., & Sylaios, G. (2021). Oil Spill Modeling: A Critical review on current trends, perspectives, and challenges. *Journal of Marine Science and Engineering*, *9*(2), 181. https://doi.org/10.3390/jmse9020181

Ketten, D. (2004). Marine mammal auditory systems: A summary of audiometric and anatomical data and implications for underwater acoustic impacts. *Polarforschung, 72*(2/3), 79-92. https://doi.org/10.2312/polarforschung.72.2-3.79

King, M. D., Elliott, J. E., & Williams, T. D. (2021). Effects of petroleum exposure on birds: A review. *Science of the Total Environment*, *755*, 142834. https://doi.org/10.1016/j.scitotenv.2020.142834.

Kingston, P.F., Dixon, I.M.T., Hamilton, S. & Moore, D.C. (1995). The impact of the Braer oil spill on the microbenthic infauna of the sediments off the Shetland Islands. *Marine Pollution Bulletin, 30*(7), 445-459. https://doi.org/10.1016/0025-326X%2895%2900052-O

KIS-ORCA (2025). *Kingfisher Information Service - Offshore Renewable & Cable Awareness website*. https://kis-orca.org/. Accessed July 2025.

Kober, K., Webb, A., Win, I., Lewis, M., O'Brien, S., Wilson, L.J. & Reid, J.B. (2010). An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs. *JNCC Report 431, ISSN 0963-8091*. https://hub.jncc.gov.uk/assets/7db38547-5074-4136-8973-fd7d97666120

Kohler, N. E., Turner, P. A., Hoey, J. J., Natason, L. J., & Briggs, R. (2002). Tag and recapture data for three pelagic shark species: blue shark (*Prinonace glauca*), shortfin mako (*Isurus xyrinchus*), and porbeagle (*Lamna nasus*) in the North Atlantic Ocean. *Collected Volumes of Scientific papers of the International Commission for the Conservation of Atlantic Tunas (ICAAT), 54*(4), 1231-1260.

Kruuk, H. & Moorhouse, A. (2006). The spatial organization of otters (*Lutra lutra*) in Shetland. *Journal of Zoology. 224*(1):41 – 57. http://dx.doi.org/10.1111/j.1469-7998.1991.tb04787.x

Kukert, H. (1991). In situ experiments on the response of deep-sea macrofauna to burial disturbance. *Pacific Science, 45,* 95.

Kvadsheim, P. H., Sevaldsen, E. M., Folkow, L. P. & Blix, A. S. (2010). Behavioural and Physiological Responses of Hooded Seals (*Cystophora cristata*) to 1 to 7 kHz Sonar Signals. *Aquatic Mammals, 36*(3), 239-247. https://www.aquaticmammalsjournal.org/wp-content/uploads/2010/10/36_3_Kvadsheim.pdf

Langangen, Olsen, E., Stige, L., Ohlberger, J., Yaragina, N., Vikebø, F., Bogstad, B., Stenseth, N., & Hjermann, D. (2017). The effects of oil spills on marine fish: Implications of spatial variation in natural mortality. *Marine Pollution Bulletin*, *119*(1), 102–109. https://doi.org/10.1016/j.marpolbul.2017.03.037.

Lanzen, A., Lekang, K., Jonassen, I., Thompson, E. M., & Troedsson, C. (2016). High-throughput metabarcoding of eukaryotic diversity for environmental monitoring of offshore oil drilling activities. *Molecular Ecology, 25*(17), 4392-4406. https://doi.org/10.1111/mec.13761

Larsen, K. M. H., Conzales-Pola, C., Fratantoni, P., Beszxzynska-Moller, A. & Hughes, S. L. (2016). ICES report on ocean climate 2014. *ICES Cooperative Research Report No. 329,* 139. Accessed June 2025.

Lee, R.F., Koster, M. & Paffenhoffer, G.A. (2012). Ingestion and defecation of dispersed oil droplets by pelagic tunicates. *Journal of Plankton Research 34*(12), 1058–1063. http://dx.doi.org/10.1093/plankt/fbs065

Lee, J.-Y., Marotzke, J., Bala, G., Cao, L., Corti, S., Dunne, J.P., Engelbrecht, F., Fischer, E., Fyfe, J.C., Jones, C., Maycock, A., Mutemi, J., Ndiaye, O., Panickal, S. & Zhou, T. (2023). Future Global Climate: Scenario-Based Projections and Near-Term Information. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 553–672. https://doi.org/10.1017/9781009157896.006.

Leuterman, A., Still, I., Johnson, J & Butcher, N. (1997). A study of trace metals from barites: their concentration, bioavailability and potential for bioaccumulation. *Proceedings of the Offshore Mediterranean Conference and Exhibition (OMC97), Ravenna, Italy, 19 to 21 March 1997.*

Lindsey, R. (2025). Climate Change: Atmospheric Carbon Dioxide. *Retrieved from NOAA Climate.gov website*: https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide

Little, C. (2000). *The biology of soft shores and estuaries (biology of habitats).* Oxford University Press. http://dx.doi.org/10.1093/oso/9780198504276.001.0001

Little, C. & Kitching, J.A. (1996). *The biology of rocky shores (biology of habitats).* Oxford University Press. https://doi.org/10.2307/5928

Lloyd's Register (2018). *Cambo FPSO site and export pipeline route- geophysical, geotechnical and environmental surveys: scope of work* (Final). Reference number 2670-SPE-SOW-02-R2.

Løkkeborg, S., Ona, E., Vold, A., & Salthaug, A. (2012). Sounds from seismic air guns: gear- and species-specific effects on catch rates and fish distribution. *Canadian Journal of Fisheries and Aquatic Sciences, 69*(8), 1278–1291. https://doi.org/10.1139/f2012-059.

Long, D. (2015). *A catalogue of tsunamis reported in the UK*. British Geological Survey Internal Report, IR/15/043. 63pp.

Macleod, K., Simmonds, M., Murray, L. (2006). Abundance of fin (*Balaenoptera physalus*) and sei whales (B. Borealis) amid oil exploration and development off northwest Scotland. Journal of cetacean research and management 8: 247-254.

Marine Directorate (2017). *Marine Mammals in Scottish Waters*. https://masts.ac.uk/wp-content/uploads/2021/05/masts-report-final-draft-natalie-ward.pdf. Accessed June 2025

Marine Directorate (2024). *Fisheries Management Measures within Scottish Offshore Marine Protected Areas (MPAs) - Strategic Environmental Assessment Environmental Report*. https://www.gov.scot/publications/fisheries-management-measures-within-scottish-offshore-marine-protected-areas-mpas-strategic-environmental-assessment-environmental-report/pages/14/. Accessed June 2025.

Marine Directorate. (2025a). *Aquaculture*. https://marine.gov.scot/node/12622. Accessed June 2025. Accessed June 2025.

Marine Directorate. (2025b). *Invasive non-native species*. https://www.gov.scot/policies/marine-environment/invasive-non-native-species/. Accessed November 2025.

Marine Directorate (2025c). 2024 Scottish Sea Fisheries Statistics - Fishing Effort and Quantity and Value of Landings by ICES Rectangles. https://data.marine.gov.scot/dataset/2024-scottish-sea-fisheries-statistics-fishing-effort-and-quantity-and-value-landings-ices. Accessed January 2026.

Marine Directorate Assessment (2020). *Wave climate*. https://marine.gov.scot/sma/assessment/wave-climate. Accessed June 2025.

Marthinsen, I., Lystad, E., Moe, K. A. & Selvik, J. R. (1992). A *synopsis of vulnerable marine resources between 68 - 58°N including the Norwegian sector of the North Sea*. Report No. 142-92-I by Cooperating Marine Scientists SA.

Masson, D.G. (2001) Sedimentary processes shaping the eastern slope of the Faeroe-Shetland Channel. *Continental Shelf Research*, 21 (8-10), 825-857. https://eprints.soton.ac.uk/7986/. Accessed June 2025.

Masson, D.G., Le Bas, T.P., Bett, B.J., Huehnerbach V., Jacobs, C.L. & Wynn, R.B (2003). Seafloor sediments and sedimentary processes on the outer continental shelf, continental slope and basin Floor. *In Strategic Environmental Assessment SEA 4 a Report to the Department of Trade and Industry*.

Maurer, D.L., Leathem, W., Kinner, P & Tinsman, J. (1979). Seasonal fluctuations in coastal benthic invertebrate assemblages. *Estuarine and Coastal Marine Science, 8,* 181-193.

McPherson, C. R., Wood, M., & Racca, R. (2016). *Potential Impacts of Underwater Noise from Operation of the Barossa FPSO Facility on Marine Fauna.* Technical Report 01117, Version 1.0. JASCO Applied Sciences, prepared for Jacobs, ConocoPhillips Barossa Project.

Met Office (2025). *Climate Dashboard Website*. https://climate.metoffice.cloud/. Accessed August 2025.

Metoc (2002). Description of Currents West of Shetland. *Prepared for BP. Briefing Note No: 977.*

Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura, & H. Zhang, (2013). Anthropogenic and natural radiative forcing. In *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K.

Allen, J. Doschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley, Eds., Cambridge University Press, pp. 659-740. https://doi.org/10.1017/CBO9781107415324.018.

Michael, P. E., Hixson, K. M., Haney, J. C., Satgé, Y. G., Gleason, J. S., & Jodice, P. G. R. (2022). Seabird vulnerability to oil: Exposure potential, sensitivity, and uncertainty in the northern Gulf of Mexico. *Frontiers in Marine Science*, *9*. https://doi.org/10.3389/fmars.2022.880750

Miller, F., Osbahr, H., Boyd, E., Thomalla, F., Bharwani, S., Ziervogel, G., Walker, B., Birkmann, J., Van Der Leeuw, S., Rockström, J., Downing, T., Folke, C. & Nelson, D. (2010). Resilience and Vulnerability: Complementary or Conflicting Concepts? *Ecology and Society, 15*(3), 11-35. https://www.ecologyandsociety.org/vol15/iss3/art11/

Mishra, A. K. & Kumar, G. S. (2015). Weathering of Oil Spill: Modeling and analysis. *Aquatic Procedia*, *4*, 435–442. https://doi.org/10.1016/j.aqpro.2015.02.058

MMT (2018). *Cambo Field development survey. Geophysical, benthic and geotechnical site and route survey*. August-September 2018. Report to Siccar Point Energy.

Molnar, J. L., Gamboa, R. L., Revenga, C. & Spalding, M. D. (2008). Assessing the global threat of invasive species to marine biodiversity. *Frontiers in Ecology and the Environment*, *6*(9), 485-492. https://doi.org/10.1890/070064

Morgan, I. (2025). *Vertical seismic profiling – UKCS Block 204/13b (West of Shetland): Underwater noise modelling assessment* (Report no. P421R0102). Subacoustech Environmental.

Moura, T., Figueiredo, I., Neves, A., Farias, I., Serra Pereira, B. & Gordo, L. S. (2006). Reproductive data on Portuguese dogfish *Centroscymnus coelolepis*, Leaf-scale gulper shark *Centrophorus squamosus* and Gulper shark *Centrophorus granulosus* commercially exploited in the Portuguese continental slope. *Working Document presented to ICES WGEF, 2006*.

Munilla, I., Arcos, J.M., Oro, D., Álvarez, D., Leyeda, P.M. & Velando, A. (2011). Mass mortality of seabirds in the aftermath of the Prestige oil spill. *Ecosphere,* 2(7): art83. https://doi.org/10.1890/ES11-00020.1

Murray, E., Dalkin, M. J., Fortune, F. & Begg., K. (1999). Marine Nature Conservation Review Sector 2. Orkney: Area Summaries. Coasts and seas of the United Kingdom – MNCR Series. *Joint Nature Conservation Committee*. https://hub.jncc.gov.uk/assets/96372864-7374-4f7e-8d0e-49da2975b133

North Atlantic Marine Mammal Commission (NAMMCO) (2017). *NAMMCO Scientific Committee Working Group on Bycatch, Copenhagen, Denmark, 2-4 May 2017*. https://nammco.no/wp-content/uploads/2017/01/report-by-catch-wg-may-2017_with-fo_corrigendum_april2020.pdf. Accessed June 2025.

North Atlantic Marine Mammal Commission (NAMMCO) (2021). *Hooded seal*. https://nammco.no/hooded-seal/#1478699758629-7da126c3-48a6. Accessed June 2025.

National Marine Fisheries Service (2005). Endangered fish and wildlife; Notice of intent to prepare an environmental impact statement. Federal Register, 70(7), 1871–1875. https://www.govinfo.gov/content/pkg/FR-2005-01-11/pdf/05-525.pdf

National Marine Fisheries Service (NMFS) (2016). Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing – Underwater acoustic thresholds for onset of permanent and temporary threshold shifts (NOAA Technical Memorandum NMFS-OPR-55). *U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), and National Marine Fisheries Service (NMFS)*. https://repository.library.noaa.gov/view/noaa/15850

National Marine Fisheries Service (NMFS) (2018). Revisions to: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (Version 2.0) – Underwater thresholds for onset of permanent and temporary threshold shifts (NOAA Technical Memorandum NMFS-OPR-59). *U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), and National Marine Fisheries Service (NMFS)*. https://www.fisheries.noaa.gov/s3//dam-migration/tech-memo-acoustic-guidance-20-pdf-508.pdf

National Marine Fisheries Service (NMFS) (2024). 2024 update to: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (Version 3.0) – Underwater and in-air criteria for onset of auditory injury and temporary threshold shifts (NOAA Technical Memorandum NMFS-OPR-71). *U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), and National Marine Fisheries Service (NMFS)*. https://www.fisheries.noaa.gov/s3/2024-11/Tech_Memo-Guidance_-3.0-_OCT-2024-508_OPR1.pdf

National Oceanic and Atmospheric Administration (NOAA). (2021). *How Oil Spills Affect Fish and Whales*. https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/how-oil-spills-affect-fish-and-whales.html. Accessed June 2025.

NatureScot (2019). *Landscape character assessment: Orkney landscape evolution and influences*. https://www.nature.scot/doc/landscape-character-assessment-orkney-landscape-evolution-and-influences. Accessed October 2025.

NatureScot (2020). *Priority Marine Features in Scotland's seas – The List.* https://www.nature.scot/doc/priority-marine-features-scotlands-seas-list. Accessed September 2025.

NatureScot (2023). *Protected Areas*. NatureScot website. https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas. Accessed July 2025.

NatureScot (2024). *Harbour seals*. https://www.nature.scot/plants-animals-and-fungi/mammals/marine-mammals/seals. Accessed June 2025.

NatureScot (2025). *GeMS Scottish Priority Marine Features*. NatureScot Maps. https://opendata.nature.scot/maps/0e722e3e911e424f8dacac5a587c0dfb/about. Accessed September 2025.

Neff, J. M. (1987). The Potential impacts of drilling fluids and other effluents from exploratory drilling on the living resources. In: *Georges bank: text and atlas*. (R.H. Backus (eds.)). *MIT Press. Cambridge, Massachusetts*.

Neff, J. M. (2005). Composition, environmental fates, and biological effects of water based drilling muds and cuttings discharged to the marine environment: a synthesis and annotated bibliography. *PERF report prepared by Battelle Ltd*.

Neff, J. M., Hillman, R. E. & Waugh, J. J. (1989). Bioaccumulation of trace metals from drilling mud barite by benthic animals. In: *Drilling Wastes* (F.R. Engelhardt, J.P. Ray and A.H. Gillam (eds.)). *Proceedings of the 1988 International Conference on Drilling Wastes, Calgary, Alberta, Canada, pp. 461-479*.

Neff, J. M., Lee, K. & DeBlois, E. M. (2002). Bioaccumulation in marine organisms: effect of contaminants from oil well produced water. https://www.researchgate.net/publication/283591978

Netto, S. A., Gallucci, F. & Fonseca, G. (2009). Deep-sea meiofauna response to synthetic-based drilling mud discharge off SE Brazil. *Deep Sea Research*, *II*(56), 41–49. https://doi.org/10.1016/j.dsr2.2008.08.018

Newell, R. C., Seiderer, L. J. & Hitchcock, D. R. (1998). The impact of dredging works in coastal waters : A review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed. *Oceanography and Marine Biology/Oceanography and Marine Biology - an Annual Review, 36*, 135–158. https://doi.org/10.1201/b12646-16

Nieukirk, S. L., Stafford, K. M., Mellinger, D. K., Dziak, R. P. & Fox, C. G. (2004). Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. *The Journal of the Acoustical Society of America, 115*(4), 1832–1843. https://doi.org/10.1121/1.1675816.

NMPi (2025). *NMPi part of Scotland's environment*. https://marinescotland.atkinsgeospatial.com/nmpi/. Accessed June 2025.

North Sea Task Force (NSTF) (1993). *North Sea Quality Status Report 1993*.— 132 pp.; Fredensborg (Olsen & Olsen).

North Sea Transition Authority (NSTA) (2017). *29th Offshore Oil and Gas Licensing Round: Shipping Density Table*. https://www.nstauthority.co.uk/media/1419/29r_shipping_density_table.pdf Accessed June 2025.

North Sea Transition Authority (NSTA) (2021). *North Sea Transition Deal*. March, 2021. https://assets.publishing.service.gov.uk/media/605b148ce90e0724c7d30c2b/north-sea-transition-deal_A_FINAL.pdf

North Sea Transition Authority (NSTA) (2022a). *Other Regulatory Issues September 2022*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1114310/Other_Regulatory_Issues_-_Sept_2022.pdf. Accessed October 2025.

North Sea Transition Authority (NSTA) (2022b). *North Sea Transition Deal – One year On*. March, 2022. https://assets.publishing.service.gov.uk/media/6238513ee90e077999320564/north-sea-transition-deal-one-year-on.pdf

North Sea Transition Authority (NSTA) (2024). March 2024 Projections of UK Oil and Gas Production and Demand. *MS Excel spreadsheet*. https://www.nstauthority.co.uk/media/dsdlwpga/nsta-march-2024-production-projections-plus-ccc-and-desnz-demand-projections.xlsx

North Sea Transition Authority (NSTA) (2025a). *Emissions Monitoring Dashboard 2024*. https://app.powerbi.com/view?r=eyJrIjoiNTAyNjA2YTQtYTM2ZS00MmNlLTljYjMtYWFjNDQ1NGNjODJjIiwidCI6ImU2ODFjNTlkLTg2OGUtNDg4Ny04MGZhLWNlMzZmMWYyMWIwZiJ9 Accessed January 2025.

North Sea Transition Authority (NSTA) (2025b). *Emissions Monitoring Report 2025. 2 September 2025*. https://storymaps.arcgis.com/stories/0d057da0fdd84f8ea7f7889a918b1903

North Sea Transition Authority (NSTA) (2025c). *The move to net zero: Overview*. https://www.nstauthority.co.uk/the-move-to-net-zero/overview/ Accessed October 2025.

North Sea Transition Authority (NSTA) (2025d). *NSTA Offshore Activities*. https://experience.arcgis.com/experience/120f3b5237d04246a0964a99779fb724. Accessed June 2025.

Norwegian Blue Forests Network (2023). *The seaweed industry: Opportunities, barriers, and next steps*. https://nbfn.no/kelp-industry-brief/. Accessed June 2025.

Norwegian Directorate of Fisheries (2024). *Statistics for Aquaculture*. https://www.fiskeridir.no/english/aquaculture/statistics-for-aquaculture. Accessed November 2025.

NRC (2003). *Ocean noise and marine mammals*. National Research Council of the National Academies, Washington DC. https://doi.org/10.17226/10564

Oh, Y., Bruhwiler, L., Lan, X., Schuldt, K., Basu, S., Thoning, K., Michel, S. E., Clark, R., Miller, J. B., Andrews, A., Aalto, T., Andrade, M., Aoki, S., Apadula, F., Arduini, J., Arnold, S., Baier, B., Bäni, L., Bartyzel, J., … Zimnoch, M. (2025). CarbonTracker CH4 2025. *NOAA Global Monitoring Laboratory*. https://doi.org/10.25925/HXKS-V755

Oil and Gas Authority (OGA) (2021). *The OGA Strategy*. https://www.nstauthority.co.uk/media/7105/the-oga-strategy.pdf. Accessed November 2025.

Oil and Gas UK (OGUK) (2009). *Accident statistics for offshore units on the UKCS 1990 to 2007*. Oil and Gas UK, Issue 1, April 2009.

Oil and Gas UK (OGUK) (2012). *Oil spill cost study - OPOL financial limits*. Joint Study commissioned by OPOL and OGUK.

Oil and Gas UK (OGUK) (2020). *UK Upstream Oil and Gas Sector - Pathway to a Net-Zero Basin: Production Emissions Targets*. https://oeuk.org.uk/wp-content/uploads/2020/09/OGUK-Production-Emissions-Targets-Report-2020-1.pdf

OilPlus (2019). *Reservoir Souring Study, Cambo Field*. Final Report Rev. 3, Doc. No. TD1318 Rep 1, OilPlus Ltd, 23/04/2019.

Ona, E., Godø, O. R., Handegard, N. O., Hjellvik, V., Patel, R., & Pedersen, G. (2007). Silent research vessels are not quiet. *The Journal of the Acoustical Society of America, 121*(4), EL145–EL150. https://doi.org/10.1121/1.2710741Skalski

Oslo and Paris Commission (OSPAR) (2007). Assessment of the impact on the marine environment of offshore oil and gas activity – an overview of monitoring results in the United Kingdom, the Netherlands and Norway. *OSPAR Commission, London, pp. 33*.

Oslo and Paris Commission (OSPAR) (2009a). *Background document on CEMP assessment criteria for the QSR 2010. Monitoring and Assessment Series* (OSPAR Publication No. 978-1-907390-08-1). OSPAR Commission. https://qsr2010.ospar.org/media/assessments/p00390_supplements/09-02e_Agreement_CEMP_Assessment_Criteria.pdf. Accessed September 2025.

Oslo and Paris Commission (OSPAR) (2009b). Background Document for Portuguese dogfish. *OSPAR Commission 469/2010*. https://qsr2010.ospar.org/media/assessments/Species/P00469_Portuguese_dogfish.pdf. Accessed June 2025.

Oslo and Paris Commission (OSPAR) (2009c). Assessment of impacts of offshore oil and gas activities in the north-east Atlantic. *OSPAR Commission*.

Oslo and Paris Commission (OSPAR) (2025a). *List of Threatened and/or Declining Species & Habitats*. https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats. Accessed June 2025.

Oslo and Paris Commission (OSPAR) (2025b). *Deep-Sea Sponge Aggregations*. https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats/habitats/deep-sea-sponge-aggregations. Accessed June 2025.

Oil Spill Response Limited (OSRL) (2018). *Oil Spill Modelling Report: West of Shetland, Well P4, North Sea, UK*. Document Number GEOM00161 R02, issued 26 July 2018.

Oil Spill Response Limited (OSRL) (2020a). *Oil Spill Modelling Report: P3 Well Blowout, Cambo Field, North Sea, UK*. Document. Number PRJ01144-01 R01, issued 6 March 2020.

Oil Spill Response Limited (OSRL) (2020b). *Oil Spill Modelling Report: FPSO, Cambo Field, North Sea, UK*. Document Number. PRJ01144-03 R02, issued 13 May 2020.

Ozhan, K., & Bargu, S. (2014). Distinct responses of Gulf of Mexico phytoplankton communities to crude oil and the dispersant Corexit EC9500A under different nutrient regimes. *Ecotoxicology, 23*(3), 370–384. https://doi.org/10.1007/s10646-014-1195-9

Park, H. J., Kim, C., & Kang, C. K. (2022). Recovery of Macrobenthic Food Web on Rocky Shores Following the Hebei Spirit Oil Spill as Revealed by C and N Stable Isotopes. *Water*, *14*(15), 2335. https://doi.org/10.3390/w14152335

Paterson, W., Russell, D. J. F, Wu, M., McConnell, B. J. & Thompson, D. (2015). Harbour seal haul-out monitoring, Sound of Islay. *Scottish Natural Heritage Commissioned Report No.894*. https://www.nature.scot/doc/naturescot-commissioned-report-894-harbour-seal-haul-out-monitoring-sound-islay

Patin, S. A. (2004). Crude Oil Spills, Environmental Impact of. *Encyclopedia of Energy, Volume 1*, 737–748. https://doi.org/10.1016/b0-12-176480-x/00410-1

Paxton, C. G. M., Scott-Hayward, L., Mackenzie, M., Rexstad, E. & Thomas, L. (2016). Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resource. JNC*C Report No. 517, ISSN 0963-8091*. https://hub.jncc.gov.uk/assets/01adfabd-e75f-48ba-9643-2d594983201e

Pearson, T. H. & Rosenberg, R. (1978). Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanography and Marine Biology: an Annual Review, 16*, 229-311.

Pike D.G., Gunnlaugsson, T., Mikkelson, B., Halldórsson, D.D., Víkingsson, G.A. (2019). Estimates of the Abundance of Cetaceans in the Central North Atlantic Based on the NASS Icelandic and Faroese Shipboard Surveys Conducted in 2015. N*AMMCO Scientific Publications 11*. https://doi.org/10.7557/3.4941.

Pierce, G. J., Begona Santos, M., Mente E., wang, J., Stowasser, G. & Boyle, P. R. (2003). An overview of Cephalopods relevant to the SEA 4 Area. *Report to the Department of Trade and Industry*.

Pinnegar, J., Blasdale, T., Campbell, N., Coates, S., Colclough, S., Fraser, H., Greathead, C., Greenstreet, S., Neat, F., Sharp, R., Simms, D., Stevens, H., and Waugh, A., (2010). Charting Progress 2 Healthy and Biological Diverse Seas Feeder Report: Section 3.4: Fish. Published by Department for Environment Food and Rural Affairs on behalf of UKMMAS. p378-505. In: *UKMMAS (2010) Charting Progress 2 Healthy and Biological Diverse Seas Feeder report (Eds. Frost, M & Hawkridge, J)*.

Pollock, C. M., Mavor, R., Weir, C. R., Reid, A., White, R. W., Tasker, M. L., Webb, A. & Reid, J.B. (2000). The distribution of seabirds and marine mammals in the Atlantic Frontier, North and West of Scotland. *JNCC, Aberdeen*.

Popper, A. N. (2003). Effects of anthropogenic sound on fishes. *Fisheries, 28*(10), 24-31. http://doi.org/10.1577/1548-8446(2003)28[24:EOASOF]2.0.CO;2

Popper, A. N., & Hawkins, A. D. (2019). An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. *Journal of Fish Biology, 94*(5), 692–713. https://doi.org/10.1111/jfb.13948.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., Coombs, S., Ellison, W. T., Gentry, R. L., Halvorsen, M. B., Løkkeborg, S., Rogers, P. H., Southall, B. L., Zeddies, D. G., & Tavolga, W. N. (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: *A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. SpringerBriefs in Oceanography*. https://doi.org/10.1007/978-3-319-06659-2

Protection of the Arctic Marine Environment (PAME) (2017). Faroe Plateau LME. *LME Factsheet Series*.https://www.pame.is/images/03_Projects/EA/LMEs/Factsheets/1_Faroe_Islands_LME_.pdf. Accessed July 2025.

Quigg, A., Parsons, M., Bargu, S., Ozhan, K., Daly, K. L., Chakraborty, S., Kamalanathan, M., Erdner, D., Cosgrove, S., & Buskey, E. J. (2021). Marine phytoplankton responses to oil and dispersant exposures: Knowledge gained since the Deepwater Horizon oil spill. *Marine Pollution Bulletin, 164*, 112074. https://doi.org/10.1016/j.marpolbul.2021.112074

Ramsar (2025). *Ramsar site information service website*. https://rsis.ramsar.org/. Accessed June 2025.

Randall, R. E. (1997). Vegetated shingle structures and shorelines. In: *Coasts and seas of the United Kingdom. Region 1 Shetland*. Joint Nature Conservation Committee, 45-47. https://data.jncc.gov.uk/data/6473ed35-d1cb-428e-ad69-eb81d6c52045/pubs-csuk-region-01.pdf

Redford, M., Rouse, S., Hayes, P. & Wilding, T. A. (2021). Benthic and fish interactions with pipeline protective structures in the North Sea. *Frontiers in Marine Science, 8*. https://doi.org/10.3389/fmars.2021.652630

Reid, J. B., Evans, P. G. H. & Northbridge, S. P. (2003). Atlas of cetacean distribution in north-west European waters. *Joint Nature Conservation Committee*.

Research Council of Norway (2012). Long-term effects of discharges to sea from petroleum-related activities. The results of ten year's research. *Oceans and coastal areas (Havkyst) programme. Oslo, 2012*.

Riahi, K., R., Schaeffer, J., Arango, K., Calvin, C., Guivarch, T., Hasegawa, K., Jiang, E., Kriegler, R., Matthews, G. P., Peters, A., Rao, S., Robertson, A. M., Sebbit, J., Steinberger, M., Tavoni, D. P. &

van Vuuren, D.P. (2022). Mitigation pathways compatible with long-term goals. In *IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-3/

Richardson, W. J., Greene, C. R., Malme, C. I. & Thomson, D. H. (1995). *Marine mammals and noise*. Academic Press Ltd, London.

Royal Society for the Protection of Birds (RSPB) (2025). Royal *Society for the Protection of Birds website*. http://www.rspb.co.uk. Accessed June 2025.

Russell, D. J. F., Jones, E. L. & Morris, C. D. (2017). Updated seal usage maps: the estimated at-sea distribution of grey and harbour seal. *Scottish Marine and Freshwater Science, 8*(25), 25. A report for the Scottish Government.

Santos, M. F. L., Lana, P. C., Silva, J., Fachel, J. G., & Pulgati, F. H. (2009). Effects of non-aqueous fluids cuttings discharge from exploratory drilling activities on the deep-sea macrobenthic communities. *Deep Sea Research*, *II* (56), 32–40. https://doi.org/10.1016/j.dsr2.2008.08.017

Saunders, P. M. (1990). Cold outflow from the Faroe Bank Channel. *Journal of Physical Oceanography, 20*(1), 28-43. https://doi.org/10.1175/1520-0485(1990)020%3C0029:COFTFB%3E2.0.CO;2

Schwacke, L. H., Smith, C. R., Townsend, F. I., Wells, R. S., Hart, L. B., Balmer, B. C., Collier, T. K., de Guise, S., Fry, M. M., Guillette, L. J., Lamb, S. V., Lane, S. M., McFee, W. E., Place, N. J., Tumlin, M. C., Ylitalo, G. M., Zolman, E. S., & Rowles, T. K. (2013). Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the *Deepwater Horizon* Oil Spill. *Environmental Science & Technology*, *48*(1), 93–103. https://doi.org/10.1021/es403610f

Scotland's Aquaculture (2025). *Scotland's aquaculture website*. http://aquaculture.scotland.gov.uk/. Accessed June 2025.

Scottish Fishermen's Federation (SFF) personal communication (2018). Raymond Hall, Industry Advisor, Scottish Fishermen's Federation. Aberdeen.

Scottish Government (2017). *Applying the waste hierarchy: guidance*. https://www.gov.scot/publications/guidance-applying-waste-hierarchy/pages/3/. Accessed November 2025.

Scottish Government (2024). *Scottish Fish Farm Production Survey 2023*. https://www.gov.scot/publications/scottish-fish-farm-production-survey-2023/. Accessed June 2025.

Scottish Government (2025). *Scottish Shellfish Farm Production Survey 2024*. https://www.gov.scot/publications/scottish-shellfish-farm-production-survey-2024/. Accessed June 2025.

Scottish Natural Heritage (SNH) (2015). Trends of otters in Scotland. *Scottish Natural Heritage*. https://www.webarchive.org.uk/wayback/archive/20220413141001/https://www.nature.scot/doc/trend-notes-otters-scotland

Scottish Wildlife Trust (2025). *The Wildlife Trusts website*. www.Scottishwildlifetrust.org.uk. Accessed June 2025.

Scripps (2025). *Scripps CO_2 Program Website*. https://scrippsco2.ucsd.edu/. Accessed August 2025.

Seneviratne, S. I., Zhang, X., Adnan, M., Badi, W., Dereczynski, C., Di Luca, A., Ghosh, S., Iskandar, I., Kossin, J., Lewis, S., Otto, F., Pinto, I., Satoh, M., Vicente-Serrano, S.M., Wehner, M. & Zhou, B. (2021). Weather and Climate Extreme Events in a Changing Climate. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1513–1766. https://doi.org/10.1017/9781009157896.013.

SERPENT (2009). *Rosebank report including Cambo sediment analysis*. SERPENT, June and July 2009.

Serreze, M. C., & Barry, R. G. (2011). Processes and impacts of Arctic amplification: A research synthesis. *Global and Planetary Change, 77*(1–2), 85–96. https://doi.org/10.1016/j.gloplacha.2011.03.004

Severin, T., & Erdner, D. L. (2019). The Phytoplankton Taxon-Dependent Oil Response and Its Microbiome: Correlation but Not Causation. *Frontiers in Microbiology*, *10*. https://doi.org/10.3389/fmicb.2019.00385

Shields, M. A., & Kedra, M. (2009). A deep burrowing sipunculan of ecological and geochemical importance. *Deep Sea Research Part I Oceanographic Research Papers, 56*(11), 2057–2064. https://doi.org/10.1016/j.dsr.2009.07.006

Shucksmith, R. J (2017). Shetland Islands Marine Region State of the Marine Environment Assessment. *NAFC Marine Centre UHI. Report for the Shetland Islands Marine Planning Partnership*. https://www.shetland.uhi.ac.uk/t4-media/one-web/uhi-shetland-images-and-documents/research/document/marine-spatial-planning/state-of-environment-assessment/shetland-state-of-the-marine-environment-assessment-april-17.pdf

Simmonds, M., Dolman, S. & Weilgart, L. (2004). *Oceans of noise: A WDCS science report*. Whale and Dolphin Conservation Society. https://uk.whales.org/wp-content/uploads/sites/6/2018/08/Oceans-of-Noise.pdf

Sims, D. W., Southall, E. J., Metcalfe, J. D & Pawson, M. G. (2005). Basking shark population assessment. Final project report for the Global Wildlife Division of DEFRA. *Cefas and The Marine Biological Association*. http://dx.doi.org/10.13140/RG.2.2.16391.98720

Siron, R., Pelletier, E., Delille, D., & Roy, S. (1993). Fate and effects of dispersed crude oil under icy conditions simulated in mesocosms. *Marine Environmental Research, 35*(3), 273–302. https://doi.org/10.1016/0141-1136(93)90098-k.

Skalski, J. R., Pearson, W. H., & Malme, C. I. (1992). Effects of sound from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes* spp.). *Canadian Journal of Fisheries and Aquatic Sciences, 49*(7), 1357–1365. https://doi.org/10.1139/f92-150

Slabbekoorn, H., Bouton, N., van Opzeeland, I., Coers, A., ten Cate, C., & Popper, A. N. (2010). A noisy spring: The impact of globally rising underwater sound levels on fish. *Trends in Ecology & Evolution, 25*(7), 419-427. https://doi.org/10.1016/j.tree.2010.04.005.

Slotte, A., Hansen, K., Dalen, J., & Ona, E. (2003). Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast. *Fisheries Research, 67*(2), 143–150. https://doi.org/10.1016/j.fishres.2003.09.046

Smith, C., Walsh, T., Gillett, N., Hall, B., Hauser, M., Krummel, P., Lamb, W., Lamboll, R., Lan, X., Muhle, J., Palmer, M., Ribes, A., Schumacher, D., Seneviratne, S., Trewin, B., von Schuckmann, K., & Forster, P. (2024). *Climate Indicator/data: Indicators of Global Climate Change 2023 revision 2*. https://doi.org/10.5281/zenodo.7883757

Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene Jr., C. R., Kastak, D., Ketten, D. R., Miller, J. H., Nachtigall, P. E., Richardson, W. J., Thomas, J. A., & Tyack, P. L. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals, 33*(4), 411- 509. https://doi.org/10.1578/AM.33.4.2007.411

Southall, B. L., Finneran, J. J., Reichmuth, C., Nachtigall, P. E., Ketten, D. R., Bowles, A. E., Ellison, W. T., Nowacek, D. P., & Tyack, P. L. (2019). Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects. *Aquatic Mammals, 45*(2), 125-232. https://doi.org/10.1578/AM.45.2.2019.125

Southall, B. L., Nowacek, D. P., Bowles, A. E., Senigaglia, V., Bejder, L., & Tyack, P. L. (2021). Marine mammal noise exposure criteria: Assessing the severity of marine mammal behavioral responses to human noise. *Aquatic Mammals, 47*(5), 421-464. https://doi.org/10.1578/AM.47.5.2021.421.

Scottish Committee on Seals (SCOS) (2024). Scientific Advice on Matters Related to the Management of Seal Populations: 2024. *Natural Environment Research Council*. https://www.smru.st-andrews.ac.uk/files/2025/05/SCOS-2024.pdf

Stone, C.J., and Tasker, M.L. (2006). The effect of seismic airguns on cetaceans in UK waters. *Journal of Cetacean Research and Management, 8*(3), 255–263. https://doi.org/10.47536/jcrm.v8i3.721.

Strachan, R., (2007). National survey of otter *Lutra lutra* distribution in Scotland, 2003 to 2004. *Scottish Natural Heritage commissioned report 211 (ROAME no F03AC309)*.

Swift, R. J., Hastie, G. D., Barton, T. R., Clark, C. W., Tasker, M. L. & Thompson, P. M. (2002). Studying the distribution and behaviour of cetaceans in the northeast Atlantic using passive acoustic techniques. *Report for the Atlantic Frontier Environmental Network*.

Takeshita, R., Bursian, S. J., Colegrove, K. M., Collier, T. K., Deak, K., Dean, K. M., De Guise, S., DiPinto, L. M., Elferink, C. J., Esbaugh, A. J., Griffitt, R. J., Grosell, M., Harr, K. E., Incardona, J. P., Kwok, R. K., Lipton, J., Mitchelmore, C. L., Morris, J. M., Peters, E. S., & Hall, A. J. (2021). A review of the toxicology of oil in vertebrates: what we have learned following the Deepwater Horizon oil spill. *Journal of Toxicology and Environmental Health, Part B, 24*(8), 355–394. https://doi.org/10.1080/10937404.2021.1975182.

Tamelander, J. Riddering, L. Haag, F. and Matheickal, J. (2010). *Guidelines for Development of National Ballast Water Management Strategies*. GEF-UNDP-IMO GloBallast, London, UK and IUCN, Gland, Switzerland. GloBallast Monographs No. 18. IMO 19613.

Tang, D., Sun, J., Zhou, L., Wang, S., Singh, R. P., & Pan, G. (2019). Ecological response of phytoplankton to the oil spills in the oceans. *Geomatics, Natural Hazards and Risk*, *10*(1), 853–872. https://doi.org/10.1080/19475705.2018.1549110

Thompson, D. (1998). *Biology of seals of the north-east Atlantic in relation to seismic surveys*. Paper presented at the seismic and marine mammals' workshop, 23 to 25 June 1998, London.

Tillin, H. M., Hull, S. C., & Tyler-Walters, H. (2010). Development of a sensitivity matrix (pressures-MCZ/MPA features). *Report to the Department of Environment, Food and Rural Affairs from ABPMer, Southampton and the Marine Life Information Network (MarLIN) Plymouth: Marine Biological Association of the UK. Defra Contract No. MB0102 Task 3A, Report No. 22*.

Trannum, H. C., Nilsson, H. C., Schaanning, M. T., & Øxnevad, S. (2009). Effects of sedimentation from water-based drill cuttings and natural sediment on benthic macrofaunal community structure and ecosystem processes. *Journal of Experimental Marine Biology and Ecology, 383*(2), 111–121. https://doi.org/10.1016/j.jembe.2009.12.0041.

Troisi, G., Barton, S., & Bexton, S. (2016). Impacts of oil spills on seabirds: Unsustainable impacts of non-renewable energy. *International Journal of Hydrogen Energy*, *41*(37), 16549–16555. https://doi.org/10.1016/j.ijhydene.2016.04.011

Turrell, W. R., Slesser, G., Adams, R. D., Payne, R. & Gillibrand, P. A. (1999). Decadal variability in the composition of the Faroe Shetland Channel bottom water. *Deep Sea Research I 46*(1-2).

Tuttle, L. J. & Donahue, M. J. (2022). Effects of sediment exposure on corals: a systematic review of experimental studies. *Environmental Evidence 11*(4). https://doi.org/10.1186/s13750-022-00256-0

Tyack, P. L. (2008). Implications for marine mammals of large-scale changes in the marine acoustic environment. *Journal of Mammalogy, 89*(3), 549–558. https://doi.org/10.1644/07-mamm-s-307r.1.

Tyler-Walters, H., James, B., Carruthers, M., Wilding, C., Durkin, O., Lacey, C., & Crawford-Avis, O. T. (2016). *Descriptions of Scottish Priority Marine Features (PMFs).* Scottish Natural Heritage Commissioned Report No. 406. https://www.nature.scot/sites/default/files/Publication%202016%20-%20SNH%20Commissioned%20Report%20406%20-%20Descriptions%20of%20Scottish%20Priority%20Marine%20Features%20%28PMFs%29.pdf.

Tyler-Walters, H., Tillin, H.M., d'Avack, E.A.S., Perry, F., & Stamp, T. (2023). *Marine Evidence based Sensitivity Assessment (MarESA) – Guidance Manual. Marine Life Information Network (MarLIN)*. Marine Biological Association of the UK, Plymouth, pp. 170. Available from https://www.marlin.ac.uk/publications

UNEP-WCMC (2025). *Protected Planet website*. https://www.protectedplanet.net/en. Accessed July 2025.

United Kingdom Hydrographic Office (UKHO) (2025). *Admiralty Marine Data Portal: Wrecks and Obstructions Shapefiles*. https://datahub.admiralty.co.uk/portal/apps/sites/#/marine-data-portal/search?tags=GlobalWrecks. Accessed June 2025.

United Nations Environment Programme (UNEP) (2024). Emissions Gap Report 2024: No more hot air … please! With a massive gap between rhetoric and reality, countries draft new climate commitments. Na*irobi. Emissions Gap Report 2024 | UNEP - UN Environment Programme*.

United Nations Framework Convention on Climate Change (UNFCCC) (2024). *Nationally determined contributions under the Paris Agreement*. Synthesis report by the secretariat. https://unfccc.int/documents/641792.

United States Environmental Protection Agency (USEPA). (1999). *Understanding Oil Spills and Oil Spill Response*. EPA Office of Emergency and Remedial Response.

University of Aberdeen & Hartley Anderson (2003). *Conservation sites in the SEA4 Area (Final Report)*. Report to the Department of Trade and Industry. https://assets.publishing.service.gov.uk/media/5a7abf2040f0b66a2fc0284f/SEA4_TR_Conservation_UOA.pdf

URS (2002). *UKOOA drill cutting initiative. Joint Industry Project - research and development programme phase II.* Task 2C water column and food chain impacts. Project 29384-010-401. United Kingdom Offshore Operators Association, London, England.

Varela, M., Bode, A., Lorenzo, J., Álvarez-Ossorio, M. T., Miranda, A., Patrocinio, T., Anadón, R., Viesca, L., Rodríguez, N., Valdés, L., Cabal, J., Urrutia, N., García-Soto, C., Rodríguez, M., Álvarez-Salgado, X. A., & Groom, S. (2006). The effect of the "Prestige" oil spill on the plankton of the N–NW Spanish coast. *Marine Pollution Bulletin*, *53*(5–7), 272–286. https://doi.org/10.1016/j.marpolbul.2005.10.005

Votier, S. C., Hatchwell, B. J., Beckerman, A., McCleery, R. H., Hunter, F. M., Pellatt, J., Trinder, M., & Birkhead, T. R. (2005). Oil pollution and climate have wide-scale impacts on seabird demographics. *Ecology Letters*, *8*(11), 1157–1164. https://doi.org/10.1111/j.1461-0248.2005.00818.x

Waggitt, J. J., Evans, P.G.H., Andrade, J. A., Banks, A. N., Boisseau, O., Bolton, M., Bradbury, G., Brereto, T., Camphuysen, C. J., Dunrick, J., Felce, T., Fijn, R.C., Garcia-Baron, I., Garthe, S., Geelhoed, S. C. V., Gille, A., Goodhall, M., Haelters, J., Hamilton, S., Hartny-Mills, L., Hodgins, N., James, K., Jessop, M., Kavanagh, A.S., Leopold, M., Lohrengel, K., Louzao, M., Markones, N., Martinez-Cedeira, J., Cadhla, O. O., Perry, S. L., Pierce, G.J., Ridoux, V., Robinson, K. P., Santos, M. B., Saavedra, C., Skov, H., Stienen, E. W. M., Sveegaard, S., Thompson, P., Vanermen, N., Wall, D., Webb, A., Wilson, J., Wanless, S., & Hiddink, J. G. (2019). Distribution maps of cetacean and seabird populations in the North-East Atlantic. *Journal of Applied Ecology*, *57*(2), 253-269. https://doi.org/10.1111/1365-2664.13525. Accessed June 2025.

Webb, A., Elgie, M., Irwin, C., Pollock, C. & Barton, C. (2016). Sensitivity of offshore seabird concentrations to oil pollution around the United Kingdom: Report to Oil & Gas UK. *Document No HP00061701*. https://data.jncc.gov.uk/data/4253a571-146c-48bf-bf06-6fb29b8f59b1/SOSI-report.pdf

Weilgart, L. S. (2007). A brief review of known effects of noise on marine mammals. *International Journal of Comparative Psychology, 20*(2). https://doi.org/10.46867/ijcp.2007.20.02.09

Weilgart, L. (2013). *A review of the impacts of seismic airgun surveys on marine life*. Paper submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, London, UK, 25–27 February 2014. Convention on Biological Diversity

Wenz, G. M. (1962). Acoustic ambient noise in the Ocean: spectra and sources. *The Journal of the Acoustical Society of America, 34*(12), 1936–1956. https://doi.org/10.1121/1.1909155

Wolski, L. F., Anderson, R. C., Bowles, A. E., & Yochem, P. K. (2003). Measuring hearing in the harbor seal (*Phoca vitulina*): Comparison of behavioral and auditory brainstem response techniques. *The Journal of the Acoustical Society of America, 113*(1), 629–637. https://doi.org/10.1121/1.1527961

World Meteorological Organization (WMO) (2020). *WMO Statement on the State of the Global Climate in 2019*. https://library.wmo.int/idurl/4/56228

World Meteorological Organization (WMO) (2025). State of the Global Climate 2024. *Retrieved from World Meteorological Organization*: https://wmo.int/publication-series/state-of-global-climate-2024

World Ocean Review 5 (WOR5) (2017). *Coasts*. https://worldoceanreview.com/en/wor-5/coastal-dynamics/the-myriad-faces-of-the-coast. Accessed September 2025.

WoRMS (2025). *Notoproctus oculatus minor* Arwidsson, 1906. https://www.marinespecies.org/aphia.php?p=taxdetails&id=335563. Accessed June 2025.

Xodus (2019). *Cambo fishing intensity study (Phase I).* Report No: L-100528-S00-REPT-001. Rev 02, 9 January 2019.

Yuewen, D., & Adzigbli, L. (2018). Assessing the impact of oil spills on marine organisms. *Journal of Oceanography and Marine Research*, *06*(01). https://doi.org/10.4172/2572-3103.1000179

A.1 Summary of Legislation

The main environmental legislation relevant to the proposed Cambo field development.

Topic	Legislation
Consenting	
Environmental Statement (ES)	The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020; The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended); The Offshore Marine Conservation (Natural Habitats &c) Regulations 2007 (as amended); The Conservation of Offshore Marine Habitats and Species Regulations 2017; The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019; The Offshore Petroleum and Pipelines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017; Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended); Convention on Environmental Assessment in the Transboundary Context (Espoo Convention) 1991.
Well Consent	The Petroleum Act 1998 (as amended). The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020; Well Operations Notification System (WONS); Offshore Petroleum Licensing (Offshore Safety Directive) Regulations 2015 (2015 licensing regulations); Drilling Operations Application (DRA) and Chemical Permit Subsidiary Application Template (SAT).
Consent to Locate	Marine and Coastal Access Act 2009; Marine (Scotland) Act 2010; The Energy Act 2008 (as amended)
Pipeline Consent	Petroleum Act 1998 (as amended); The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020; Pipeline Safety Regulations 1996, as amended; Marine and Coastal Access Act 2009; Marine Scotland Act 2010; Pipeline Works Authorisation (PWA) and consent to deposit of materials on the Seabed (DEPCON); Pipeline Operations MAT (PLA), Chemical Permit SAT (CP), EIA Direction for Pipeline Operations SAT (PL), and EIA Direction for Deposits SAT (PL).

Topic	Legislation
Production Consent	Petroleum Act 1998 (as amended); The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020; Offshore Petroleum Licensing (Offshore Safety Directive) Regulations 2015 (2015 licensing regulations); Production Operations MAT (PRA) and EIA Direction for Commencement of Production SAT (PR).
Produced Water	Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005, as amended; Production Operations MAT (PRA) and Oil Discharge Permit (Life) SAT (OLP).
Routine Operations	
Sewage Discharges	MARPOL 73/78 Annex IV Prevention of Pollution by Sewage from Ships; Annex V of MARPOL 73/78 (including amendments) - Regulations for the Prevention of Pollution by Garbage from Ships Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008; Food and Environment Protection Act 1985 (FEPA); Deposits in the Sea (Exemption) Order 1985; Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention).
Oil Contaminated Discharges	Offshore Chemical Regulations 2002, as amended; Offshore Petroleum Activities (Oil Pollution Prevention and Control) (OPPC) Regulations 2005, as amended; Food and Environment Protection Act 1985 (FEPA); Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention); OSPAR Decision 2000/3 on the Use of Organic-phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings; OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles.
Water Based Mud (WBM) Cuttings	Offshore Chemical Regulations 2002, as amended; Offshore Petroleum Activities (Oil Pollution Prevention and Control) (OPPC) Regulations 2005, as amended; Food and Environment Protection Act 1985 (FEPA); Deposits in the Sea (Exemptions) Order 1985; OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles.
Chemical Use	Pollution Prevention and Control Act 1999; The Offshore Chemicals Regulations 2002, as amended; The REACH Enforcement Regulations 2008, as amended; Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention);

Topic	Legislation
	OSPAR Recommendation 2006/3 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that are, or which contain Substances Identified as Candidates for Substitution; OSPAR Recommendation 2005/2 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that Are, or Contain Added Substances, Listed in the OSPAR 2004 List of Chemicals for Priority Action; OSPAR Recommendation 2000/2 on a harmonised mandatory control system for the use and reduction of the discharge of offshore chemicals as amended by OSPAR Decision 2005/1; Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005, as amended (OPPC); Food and Environment Protection Act 1985 (FEPA); Deposits in the Sea (Exemptions) Order 1985.
Drainage Water	Offshore Petroleum Activities (Oil Pollution Prevention and Control) (OPPC) Regulations 2005, as amended; Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention); PARCOM Recommendation 86/1 of a 40 mg/l Emission Standard for Platforms; Merchant Shipping (Prevention of Oil Pollution) Regulations 1996, as amended; Merchant Shipping Act 1995; International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78; Merchant Shipping (Prevention of Oil Pollution) (Amendment) Regulations 1994.
Atmospheric Emissions	
Turbine/Combustion Emissions	MARPOL 73/78 Annex VI Prevention of Air Pollution from Ships; Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, as amended; Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2001, as amended; The Greenhouse Gas Emissions Trading Scheme Order 2020, as amended; The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013; Climate Change Act 2008; National Emission Ceilings Regulations 2002; Pollution Prevention and Control Act 1999.
Halocarbons (halons, CFCs)	Ozone Depleting Substances Regulations 2015; Fluorinated Greenhouse Gases Regulations 2015; MARPOL 73/78 Annex VI Prevention of Air Pollution from Ships; The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, as amended.
Flaring and Venting	Energy Act 1976;

Topic	Legislation
	Energy Act 2016; Petroleum Act 1998 (as amended); Petroleum Licensing (Exploration & Production) (Seaward and Landward) Regulations 2004; The Petroleum (Current Model Clauses) Order 1999; Climate Change Act 2008; The Greenhouse Gas Emissions Trading Scheme Order 2020, as amended; National Emission Ceilings Regulations 2002; Waste and Emissions Trading Act 2003.
Routine Drilling Operations	
Chemical Transport	
Bulked Chemicals	Environmental Protection Act 1990; Merchant Shipping (Dangerous or Noxious Liquid Substances in Bulk) Regulations 1996, as amended.
Dangerous Goods	Environmental Protection Act 1990; Controlled Waste Regulations 1992, as amended; The Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997; The Environmental Protection (Duty of Care) (Scotland) Regulations 2014; The Waste (Scotland) Regulations 2011.
Hazardous Chemicals	Environmental Protection Act 1990; Controlled Waste Regulations 1992, as amended; Chemicals (Hazard Information and Packaging for Supply) Regulations 2009; The Environmental Protection (Duty of Care) (Scotland) Regulations 2014; The Waste (Scotland) Regulations 2011, as amended.
Wildlife Protection (Offshore)	
Habitats and Species	Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (Offshore Marine Regulations, OMR), as amended; The Conservation of Habitats and Species Regulation 2010, as amended; The Conservation of Offshore Marine Habitats and Species Regulations 2017; The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019; The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001; The UK Marine and Coastal Access Act 2009;

Topic	Legislation
	The Marine (Scotland) Act 2010.
Cetaceans	The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001, as amended; Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas 1991 (ASCOBANS); Wildlife and Countryside Act (1981); Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (Offshore Marine Regulations, OMR), as amended; The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019.
Waste Handling	
Transfer of Oil Contaminated Wastes	Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005, as amended; Merchant Shipping (Prevention of Oil Pollution) Regulations 1996; Prevention of Pollution (Reception Facilities) Order 1984; Merchant Shipping and Maritime Security Act 1997.
Waste	Food and Environment Protection Act 1985, as amended; Deposits in the Sea (Exemptions) Order 1985; Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008.
Transfer of Waste/Garbage from Installations	Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008; Food and Environment Protection Act 1985, as amended; Deposits in the Sea (Exemptions) Order 1985; Environmental Protection (Duty of Care) Regulations 1991; Waste Management Licensing (Scotland) Regulations 2011; Waste (Scotland) Act 2011.
Transfer of Special Waste	Environmental Protection Act 1990; Controlled Waste Regulations 1992, as amended; Special Waste Regulations 1996, as amended; The Special Waste Amendment (Scotland) Regulations 2004; The Environmental Protection (Duty of Care) (Scotland) Regulations 2014; The Waste (Scotland) Regulations 2011, as amended.
Radioactive Waste	Radioactive Substances Act 1993 (RSA 93), as amended; Radioactive Substances (Phosphatic Substances, Rare Earths etc.) Exemptions Order 1962; Radioactive Substances (Substances of Low Activity) Exemption Order 1986, as amended;

Topic	Legislation
	Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997.
Support Vessels	
Machinery Space Drainage from Shipping	The Merchant Shipping (Prevention of Oil Pollution) Regulations 1996, as amended; Merchant Shipping Act 1995; International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78.
Sewage from Vessels	MARPOL 73/78 Annex IV Regulations for the Prevention of Pollution by Sewage from Ships; Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008; Deposits in the Sea (Exemption) Order 1985; Food and Environment Protection Act 1985, as amended.
Garbage from Vessels	Food and Environment Protection Act 1985, as amended; Deposits in the Sea (Exemption) Order 1985; Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008.
Atmospheric Emissions from Vessels	The Merchant Shipping (Prevention of Air Pollution from Ships) Order 2006; MARPOL 73/78 Annex VI - Prevention of Air Pollution from Ships, the regulations in this annex set limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibit deliberate emissions of ozone depleting substances; The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008.
Accidental Events (Installations)	
Oil Pollution Emergency Planning	Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998, as amended; Offshore Installations (Emergency Pollution Control) Regulations 2002; Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995; The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005, as amended.
Spill Reporting	Model Clauses of Licence; Petroleum Operations Notice no 1.
Accidental Events (Vessels)	
Spills, Release or Possible Escape of Oil, Noxious Substance or Marine Pollutant	Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998, as amended; Merchant Shipping (Oil Pollution, Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015; Merchant Shipping (Reporting of Pollution Incidents) Regulations 1987; Merchant Shipping (Reporting Requirements for Ships Carrying Dangerous Polluting Goods) Regulations 1995; Petroleum Operations Notice no 1;

Topic	Legislation
	Offshore Installations (Emergency Pollution Control) Regulations 2002.
Decommissioning	
Well Suspension and Abandonment	Petroleum Act 1998 (as amended); Energy Act 2008; The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005, as amended; Offshore Chemicals Regulations 2002; Offshore Chemicals (Amendment) Regulations 2011; Marine and Coastal Access Act 2009 (MCAA); Marine Scotland Act 2010; Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001, as amended; The Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2007; Petroleum (Production) (Seaward Areas) Regulations 1988, as amended; Offshore Installations and Wells (Design and Construction etc) Regulations 1996; Food and Environment Protection Act 1985; Well intervention Permit via the UK Oil Portal, FEPA licence may be required, or a Marine Licence for deposits on the seabed. A MCAA licence via the UK Oil Portal.

A.2 Commitments Register

The following table summarises the mitigation commitments made in each of the impact sections of this Environmental Statement (ES) (Sections 8 to 14). These commitments will inform the planning stages for the Cambo field development (drilling and completion operations, Floating Production, Storage and Offloading Vessel (FPSO) installation and operation, and subsea infrastructure installation and operation) and will be incorporated into the Ithaca Energy Project Statement of Requirements and Operations Philosophy. Where relevant, they will also form the basis of the Environmental Management Plan (EMP). Ithaca SP E&P Limited is appointed as Well Operator for Cambo. An application to appoint an Installation Operator will be made at a later date. The EMP will also implement all relevant requirements of the environmental management systems of the Well Operator (Ithaca SP E&P Limited) and Installation Duty Holder for this specific project.

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
Physical Presence					
Potential for pipeline laying vessel, MODU and FPSO to be a navigation hazard for shipping and other users	Safe working distances will be imposed, for the duration of operations.	✓		✓	✓
	500 m safety zones will be put in place around field infrastructure.	✓		✓	✓
	FPSO and infield infrastructure 500 m safety zones will be enforced during operations by a dedicated Emergency Response and Rescue Vessel (ERRV).	✓		✓	✓
	All construction vessels will be highly visible and display the appropriate light or daytime signals. The FPSO will be highly visible and be in full compliance with the necessary legal requirements.	✓		✓	✓
	A Vessel Traffic Study has been prepared for the proposed development location.	✓	✓		
	Notice to mariners will be posted prior to the wet storage of mooring lines on the seabed and to the MODU and FPSO moving onto location, ensuring that all vessels, including fishing vessels, will be aware of its presence in advance and for the duration of operations.	✓	✓	✓	
	The UK Hydrographic Office (UKHO) will be notified so that admiralty charts can be amended to mark the position of the FPSO and gas export pipeline infrastructure.	✓	✓	✓	✓
Potential for MODU or FPSO to be an obstruction to fishing operations	A guard vessel and / or an ERRV will be present to warn any fishing boats entering the area during drilling, installation and production operations.	✓	✓	✓	✓
	Kingfisher will be notified of the exact location of the MODU and FPSO prior to moving onto location, allowing its inclusion in their fortnightly bulletin to fishing vessels.		✓	✓	✓
	The UKHO will be notified so that charts can be amended to mark the position of the FPSO and gas export pipeline infrastructure.	✓	✓	✓	✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
Potential for Gas Export Pipeline to be an obstruction to fishing operations	The UKHO will be notified so that charts can be amended to mark the position of the FPSO and gas export pipeline infrastructure.	✓	✓	✓	✓
Atmospheric Emissions					
Emissions to the atmosphere from power generation on the MODU/FPSO/support and supply vessels	Waste heat from the turbines will be used to provide process heating requirements through the installation of Waste Heat Recovery Units (WHRUs).		✓	✓	✓
	All equipment will operate at optimum efficiency and be well maintained according to a strict maintenance regime.		✓	✓	✓
	FPSO will run on dual fuel units that are gas fuel Dry low NOx (DLE)/liquid fuel Lean Direct Injection (LDI) equipped		✓		✓
	Only low sulphur diesel will be used onboard MODU and FPSO.			✓	✓
	Optimising fuel use during drilling operations including batch drilling of the wells.		✓	✓	
	Atmospheric emissions from the MODU and the FPSO will be reported under EEMS.	✓		✓	✓
Net Zero targets	Comply with the North Sea Transition Deal and industry Net Zero targets, including a 50 % reduction in 2030 to 90 % in 2040 (against a 2018 baseline) and to become a net zero basin by 2050	✓		✓	✓
	The Cambo FPSO will be designed, and necessary pre-investment made, to facilitate potential future electrification (either from on or offshore renewable sources) without the need to remove the FPSO off-station for modification. Specifically, provisions are being made in the FPSO design to accommodate potential future installation of a power import connection and required electrical infrastructure for power conditioning and distribution.		✓		✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
	Ithaca Energy will, through its previous engagement with the West of Shetland Operator Electrification Workgroup, continue to explore opportunities to overcome the technical and financial challenges currently prohibiting the import of electricity from renewable sources to meet the Cambo FPSO power requirements.		✓		
Drilling Discharges					
Drilling discharges affecting nature conservation features	Environmental baseline survey and habitat investigation of the proposed well locations were undertaken in 2025, which confirmed no protected features were present in the vicinity of the proposed well locations.		✓	✓	
Discharge of chemicals into the marine environment during drilling activities	Selection of chemicals will be based upon both their technical specifications and their environmental performance, with reference to the CEFAS templates, to ensure the most environmentally benign chemicals will be selected. Use and discharge of chemicals will be minimised where practicable.	✓	✓	✓	
	The actual mud and chemical usage will be monitored during drilling operations and subsequently reported to OPRED via the UK Environmental Emissions Monitoring System (EEMS).	✓	✓	✓	
Discharge of cement into the marine environment (note that the Primary well foundations will be set with a CAN-Ductor, significantly reducing cement discharge to seabed)	Use of ROV to visually monitor cement returns to seabed surface.			✓	
	Once returns are observed, pumping will be stopped in order to minimise discharged volume.	✓		✓	
Discharge of cuttings and Water Based Muds (upper and lower well sections)	A closed mud circulation system will be used, so the returned drilling fluids can be reused, reducing total fluid volumes.			✓	
	The drilling mud and cuttings discharged from the drilling rig will be discharged close to the sea surface, allowing dilution and dispersion over a large area.			✓	

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
	Drill cuttings contaminated with mud will be discharged close to the sea surface, allowing dilution and dispersion over a large area and thereby minimising the overall environmental impact.			✓	
	Oil content of payzone cuttings will be measured onboard the drilling rig, and a number of samples returned to shore for further analysis and verification. If the oil concentration on cuttings exceeds the limits described in the OPPC permit, cuttings discharge will be ceased, and cuttings collected onboard the MODU and shipped back to shore for appropriate disposal.	✓		✓	
Discharge of cuttings and Low Toxicity Oil Based Muds (lower well sections)	If used to drill the lower well sections, all spent low toxicity oil based mud (LTOBM) will be collected onboard the MODU and will either be contained and shipped to shore for appropriate treatment and disposal or, alternatively, will be thermally treated offshore and disposed to sea (cuttings treated to well below the 1 % oil (in weight) discharge threshold).	✓		✓	
Produced Water and Marine Discharges					
Discharges of produced water containing dispersed oil	The Produced Water Treatment Package will be designed to achieve a dispersed oil content target of ≤ 15 mg/l (on a monthly average basis) prior to overboard disposal.	✓	✓		✓
Temperature of discharged produced water	The Produced Water Treatment Package will reduce untreated produced water temperature to be discharged to sea to 27 °C. This will form part of the design target / specification for the FPSO to ensure the RBA dilution rates of 400 at ~4,404 m from the discharge is met under all meteorological conditions under the worst-case modelled scenario.		✓		✓
Orientation of discharges of produced water from the FPSO	The design / specification of the FPSOs discharge caisson for disposing of produced water will be based on a diameter of 203 mm with a downwards discharge angle of 30 ° at a depth of 9 m. These parameters will increase the horizontal distance travelled during the near-field propagation stage and further improves predicted dilution factors.		✓		✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
Discharges of ballast water from the MODU/FPSO	The vessels will comply with IMO Ballast BWM Convention IMO-approved ballast water treatment systems will be in place. The conduction of ballast water exchange will be undertake in designated offshore areas and a Ballast Water Record Book will be maintained. Ballast water treatment and management plans should be approved and followed. Anti-fouling coatings will be used for vessels, sampling equipment will be cleaned up prior to any offshore use and priority will be given to use of vessels from within the region.	✓	✓	✓	✓
Underwater Generation and Wildlife Disturbance					
Underwater sound produced by the MODU, FPSO, supply vessels and shuttle tankers	Logistics will be optimised to minimise unnecessary or low payload helicopter flights and vessel sailings.	✓	✓	✓	
Underwater sound produced by the Vertical Seismic Profile (VSP) survey	Underwater sound generated during VSP survey operations will be kept to a minimum where possible.	✓	✓	✓	
	VSP survey operations at the optional appraisal well will be conducted in accordance with the "*JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys*". This includes a Marine Mammal Observer (MMO) to undertake a pre survey search for marine mammals and the use of "soft start" procedures.	✓	✓	✓	
Waste Management					
Legislation and Guidance	The appropriate legislation and guidance will be adhered regarding management of waste, including adherence to the Waste Hierarchy.	✓	✓	✓	✓
Waste generated by the project	Compliance with Ithaca Energy's Waste Management Procedures for waste produced during the proposed development activities. Waste will be segregated onboard the MODU, FPSO, and other vessels and returned to shore for appropriate treatment and disposal through licensed contractors and sites.	✓	✓	✓	✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
Segregation of waste	The MODU and FPSO will be designed with adequate space for waste storage and segregation facilities, including laydown areas for skips and deck space for other waste storage receptacles. Waste will be segregated into hazardous and non-hazardous waste types.	✓	✓	✓	✓
Documented waste	Compliance with Ithaca Energy's Waste Management Plan and use of a Garbage Management Plan for the management of waste produced from vessels. The amount and disposal route of any waste will be recorded in the UK EEMS.	✓	✓	✓	✓
Accidental Events (Preventative Measures)					
Training, experience and suitability of equipment	In order to prevent an oil spill occurring, stringent safety and operational procedures will be followed at all times. Before offshore operations commence, the Installation/Well Operator will fully assess the competence and experience of all contractors, and the suitability of all equipment to operate in the West of Shetland area.	✓	✓	✓	
	All offshore personnel will be appropriately trained, experienced and certified to carry out their specific duties. The crew of the FPSO and the MODU will also undergo environmental awareness and safety training.	✓	✓		✓
Well design	The wells will be designed to minimise the potential for well control problems.	✓	✓		
	An independent, thorough and formal peer-review approach will be used to review all critical elements of the well design and the execution of drilling and abandoning the well. The well design will be independently reviewed by a Well Examiner, who will also monitor the actual construction and any modifications to the wells.	✓	✓		
	Any deviation to the drilling programme, well design or construction, will be subject to a formal management of change process.	✓	✓	✓	
Well control	A full risk assessment will be performed as part of the planning phase of each well.	✓	✓		

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
[Note: the ticks in the right-hand columns relate to the BOP and all backup control systems]	Data on well pressure will be monitored throughout the drilling operations.	✓		✓	
	A Blow Out Preventer (BOP) will be put in place to prevent the uncontrolled release of hydrocarbons from the well. The BOP will be fully redundant and has several other backup emergency control systems, namely: ■ Emergency Disconnect System ■ Autoshear System ■ Acoustic Control System ■ Remotely Operated Vehicle ■ Automatic Mode Function	✓	✓	✓	
	The BOP will be independently inspected and verified periodically. Regular testing of the BOP and its back up systems takes place onboard the MODU, typically at 7 and 21-day intervals.	✓	✓	✓	
Diesel/Fuel Oil Bunkering and Crude Oil Tanker Offloading Procedures	Vessel audits will be performed to confirm sea worthiness of supply vessels and shuttle tankers, and only DP vessels will be used.	✓	✓		
	Bunkering and offloading operations will only take place in suitable weather conditions, and with a dedicated and continuous watch posted at both ends of the fuel/offloading hose. Where offtake operations require to be undertaken during periods of low visibility, initial connection operations for crude offtake will be limited to connection and planned disconnection during daylight hours only, with offloading within the prescribed weather limitation continuing throughout the night.	✓	✓	✓	✓
	All hoses used during bunkering/offloading will be segmented with pressure valves that will close automatically in the event of a drop in pressure. Bunkering/offloading hoses will be stored on reels, to prevent wear and damage. Hoses will be visually inspected and their connections tested prior to every loading operation. Bunkering/offloading procedures will be followed throughout all bunkering/offloading operations.	✓	✓	✓	✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
Other safety measures	All equipment used on the FPSO and the MODU will have safety measures built in to minimise the risk of any hydrocarbon spillage. The FPSO and the MODU will have open and closed drain systems in place that will route any operational spills onboard the FPSO or MODU to the slop tanks. All supply vessels will operate via Dynamic Positioning (DP).		✓	✓	✓
Accidental Events (Action to Stop a Subsea Spill During Drilling with the MODU)					
Initial actions	Use the ROV to identify the source of a leak.			✓	
	If at any time the safety of the MODU becomes compromised, the first priority will be to close the BOP, disconnect the MODU from the well, and move off location. The ERRV would monitor the spill.			✓	
	If MODU has not been disconnected, other methods include: varying the pump rate and the use of various chemicals, such as weighting material. Therefore, a contingency stock of cement and barite will be kept onboard the MODU. Once control of the well has been regained, the well can be fully abandoned with cement plugs.			✓	
Capping the well	If BOP has failed, the possibility of fitting a temporary capping device to the well will be considered. Ithaca Energy is a member of Oil Spill Response Ltd (OSRL), which allows Ithaca Energy access to the OSPRAG (the Oil Spill Prevention and Response Advisory Group) Capping Device stored at the Cameron facility in Aberdeen.		✓	✓	
	A full timetable for the capping device procedure will be provided in the Well Operator's Temporary Operations Oil Pollution Emergency Plan (TOOPEP) covering the drilling operations at Cambo operations.		✓	✓	
Drilling a relief well	An assessment of the suitability of available MODUs will be undertaken and the availability of these rigs will continue to be monitored throughout the drilling operations at Cambo.		✓	✓	

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
	If attempts to cap the well fail, the only remaining option to bring the well back under control to stop the spill may be to drill a relief well. Ithaca Energy will comply with the Offshore Energies UK guidance "Relief Well Planning for Offshore Wells". Planning for drilling of a relief well will be progressed in parallel to the fitting of a temporary capping device.		✓	✓	
	Relief well plans, and trajectories, will be created for each well drilled along with a relief well kill analysis.		✓	✓	
Accidental Events (Oil Spill Response)					
Oil Pollution Emergency Plans (OPEP)	A dedicated OPEP will be prepared covering production operations at the Cambo field.	✓	✓		✓
	Ithaca Energy will ensure that any MODU working in the Cambo field will have an approved Non Production Installation Oil Pollution Emergency Plan (NPI OPEP) in place.	✓	✓	✓	
	Ithaca Energy will ensure that an approved Temporary Operations Oil Pollution Emergency Plan (TOOPEP) is in place to cover the planned drilling operations.	✓	✓	✓	
	The OPEP, NPI OPEP and TOOPEP will all conform to the Merchant Shipping (Oil Pollution, Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015 and the Offshore Installations (Emergency Pollution Control) Regulations 2002.	✓	✓	✓	✓
Training, exercises and experience	Specific members of the FPSO/MODU and standby vessel crew will have undertaken appropriate OPEP level oil spill response training. The Offshore Installation Manager (OIM) and the Installation/Well Operator offshore representative will have undertaken the OPRED course for On-Scene Commander (OPEP Level 1).		✓	✓	✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
	As a minimum, the TOOPEP and OPEP will be distributed to personnel with designated duties in the event that an oil spill response is required, and to the regulatory authorities and statutory consultees. On receipt of the TOOPEP and OPEP, personnel will undergo awareness training in oil spill response prior to the commencement of drilling operations.	✓	✓	✓	✓
	The FPSO and MODU members will regularly undertake training exercises, including vessel-based oil spill response exercises for the crew and an Offshore TOOPEP Exercise while on site, to ensure that offshore personnel are familiar with the TOOPEP and their responsibilities during a response. Similar offshore exercises will be held periodically for the Cambo Field OPEP, once it is in operation.	✓		✓	✓
	Training will also be organised for key onshore personnel in line with the OPRED requirements and the internal requirements of environmental training and continual improvement in the Well Operator's Management Systems. Ithaca Energy is a member of Oil Spill Response Ltd (OSRL), with activation rights being provided to the Installation/Well Operator. A response advisor with OPEP Level 4 training would also be provided by OSRL.		✓	✓	✓
Accidental Events (Oil Spill Response Strategies)					
Response strategies	In general, there are several response strategies which could be deployed in the event of an oil spill: ■ Natural dispersion and monitoring. ■ Application of chemical dispersants. ■ Containment and recovery (surface and subsea). ■ Shoreline protection and clean-up.			✓	✓
Natural dispersion and monitoring	Small to medium crude spill and diesel spills of all sizes are often best monitored but otherwise left to naturally degrade, but will be monitored. A standby vessel will be on site at all times during drilling and production operations. A contract with OSRL is in place, allowing the rapid deployment of a dedicated aerial surveillance aircraft.			✓	✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
	In the short term, aerial surveillance may also be undertaken by the helicopter contractor.			✓	✓
	For larger ongoing spills, aircraft may be mobilised to undertake aerial surveillance.			✓	✓
	Manual predictions, which can be used to estimate the movement of the oil on the sea surface, and oil spill modelling software would also be employed to gain a more accurate indication of oil spill movement, using real time parameters to assist the predictions.			✓	✓
Chemical dispersants	Ithaca Energy will consider applying chemical dispersants, to aid natural dispersion of a large oil spill, or when sensitive receptors such as flocks of seabirds are at risk. The decision to use chemical dispersants will assess its positive benefits, against any resulting impacts in the water column.			✓	✓
Shoreline protection and clean-up	In the event of a spill, the first priority should be to prevent spilled hydrocarbons from reaching coastal areas. The initial response to any spill will be onsite and aerial surveillance to track its movement supplemented by modelling to predict which shorelines the spilled oil may threaten. Once the coastal sensitivities under immediate threat have been identified, coastal protection resources will be deployed to protect priority areas. Although Ithaca Energy and the Installation/Well Operator will provide all necessary assistance as required, all shoreline protection strategies will be determined by the local authority in consultation with their environmental advisors. Additional response personnel and appropriate shoreline protection equipment will be provided by Ithaca Energy and the Installation/Well Operator, through their oil spill response contractor, OSRL.	✓	✓	✓	✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
	Every effort will be made to clean-up up any oil that reaches the shoreline. Depending on the type of coastline affected, various methods exist to remove oil from the shore. With all required assistance and information provided by Ithaca Energy and the Installation/Well Operator, the strategy for shoreline clean-up ultimately will be directed by the affected local authorities. Appropriately trained personnel and clean-up equipment will be made available to assist any clean-up operations, through OSRL.	✓	✓	✓	✓
Accidental Events (Liability and Insurance)					
Liability and insurance	Ithaca Energy will ensure that it has sufficient finances and insurance in place to cover the cost of responding to a large oil spill.	✓	✓	✓	✓
	Ithaca Energy is a member of the Offshore Pollution Liability Association Limited (OPOL). OPOL is a voluntary oil pollution compensation scheme to which all offshore operators currently active on the UKCS are party to.	✓	✓	✓	✓
	Ithaca Energy will ensure that sufficient finance or insurance/indemnity provision is available to cover the drilling of relief wells (if required).	✓	✓	✓	✓
Accidental Events - Loss of the MODU, Vessel or Helicopter					
Loss of the MODU, Vessel or Helicopter	All supply vessels will operate via DP, to reduce the likelihood of a collision.			✓	✓
	A 500 m exclusion zone will be enforced around the MODU for general shipping in the area.	✓		✓	✓
	A standby vessel will be on site through the life of the field to enforce the 500 m exclusion zone and be equipped with radar and communication equipment so that any vessel in the area can be detected and contacted, if required.	✓		✓	
	The MODU and associated vessels will use appropriate marking and lighting.	✓		✓	✓

Project Aspect	Mitigation or Best Practice	Regulatory Commitment	Stage of Operations		
			Planning/ Preparation	Installation/ Drilling	Production
	The suitability of supply, other support vessels and the helicopter will be assessed before they are contracted.		✓		
	The United Kingdom Hydrographic Office (UKHO) will be kept informed of drilling activities.	✓		✓	
Accidental Events - Natural Disasters					
Vulnerability of projects to risks of major accidents	The above sea and subsea infrastructure used at the Cambo field will be structurally sound, designed to withstand a number of different loads. Safety procedures will also be implemented, such as making the operations/installations safe or potentially shutting down operations, if such extreme weather events are experienced. This is in combination with emergency procedures described in TOOPEP and OPEP.	✓	✓	✓	✓

A.3 ENVID Matrices

Table 1: Impact Scoping Matrix 1: Drilling and Completion Operations

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
General Operations																				
Physical presence of the MODU and support vessels resulting in a shipping and fishing hazard.	Potential for the MODU to be a navigation hazard.	Physical presence										Y	Y	N	N				Yes	
Physical presence of wellheads/CAN-ductors.	Potential for obstruction to fishing operations and navigation resulting from the presence of wellheads.	Physical presence										Y	Y	N	N				Yes	Fishing activity (trawling) is considered unlikely at these depths.
Installation and use of CAN-ductors.	Seabed impacts from the placement of infrastructure.	Physical presence			N	Y	Y	N	N										Yes	
Resource use during drilling operations.	The single use of various resources during installation operations, including furniture, stationary, electrical equipment, steel, refrigerants and radioactive substances will be required.	Resource usage														N	N	N	No	
MODU / support and supply vessels - Diesel usage for power generation	Use of diesel for power generation.	Resource usage														N	N	N	No	
MODU / support and supply vessels- General noise and vibration of equipment whilst operating (below sea level).	Production of sound below sea level (e.g. from thrusters) will cause underwater noise.	Noise and visual impacts			N	N	Y	N	Y										Yes	
MODU / support and supply vessels / Helicopter - General noise and vibration of equipment whilst operating (on sea surface)	Production of sounds on the sea surface (including transfer routes) will cause noise in the air.	Noise and visual impacts			N	N	N	N	N										No	
Lighting during operations	Artificial light is emitted from the MODU and may attract birds	Noise and visual impacts			N	N	N	N	N										No	
Discharges and Emissions																				
MODU / support and supply vessels - Discharge of domestic sewage	Sewage has high BOD resulting from organic and other nutrient matter in the detergents and human wastes, which may affect water quality.	Discharge to sea			N	N	N	N	N										No	

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
MODU / support and supply vessels - Release of food waste to sea	Waste has high BOD resulting from organic and other nutrient matter, which may affect water quality.	Discharge to sea			N	N	N	N	N										No	
Oily water discharge during drilling and workover operations	Discharges of oily water may occur during drilling and workover operations. Oily residues in the discharged volumes may include reservoir hydrocarbons, which may affect water quality.	Discharge to sea			N	N	N	N	N										No	
Discharge of payzone cuttings	Payzone cuttings may contain oily residue, which may affect water quality.	Discharge to sea			N	Y	Y	N	N										Yes	In the event of using WBM (if using OBM no discharge unless treated).
Discharge of cuttings and Water Based Muds (top hole)	Water Based Mud (WBM), drill cuttings, drilling muds from top-hole sections are deposited directly onto the seabed during drilling operations, forming a cuttings pile around the wellhead.	Seabed Impacts			Y	Y	Y	N	N										Yes	Planned use of CAN-ductor will mitigate potential impacts.
Discharge of cuttings and Water Based Muds (lower well sections)	Drilling of deeper well sections: Discharge of cuttings and muds at the sea surface. Presence of WBM contaminated cuttings piles on seabed.	Seabed impacts			Y	Y	Y	N	N										Yes	
Discharge of cement	Once each section has been drilled, a casing will be cemented into place, and any excess cement will be discharged at the seabed.	Discharge to sea			Y	Y	Y	N	N										Yes	
Discharge of chemicals	Discharge of chemicals, including those used for drilling and completion operations and those used on the MODU (e.g. rig wash), into the marine environment.	Discharge to sea			Y	Y	Y	N	N										Yes	
Atmospheric emissions from routine operations.	Energy generation on board the MODU contributes to atmospheric emissions of greenhouse gases (CO_2, CO, SO_X, NO_X etc.).	Atmospheric emissions	Y	Y															Yes	

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
Discharge of ballast water from MODU	Potential to introduce alien species.	Discharge to sea			Y	Y	Y	N	N										Yes	
Waste																				
General operational waste - Hazardous	Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	Solid waste														N	N	N	No	Waste management section to be included in ES in line with recent comments from OPRED.
General operational waste - Non hazardous	Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	Solid waste														N	N	N	No	Waste management section to be included in ES in line with recent comments from OPRED.
Logging and Testing																				
Wireline, logging while drilling etc	Generation of electromagnetic fields, acoustic waves, microwaves, etc	Electromagnetic radiation			N	N	N	N	N										No	Limited wireline expected.
VSP on one of the drilled wells	Generation of underwater noise during VSP	Generation of underwater noise			N	N	N	Y	Y										Yes	Potential for VSP to be undertaken on one of the wells.
Emergency / Accidental Events																				
Large oil spill from the MODU, requiring mobilisation of all available internal and external oil spill response resources (e.g. fuel oil spillage from MODU / support and supply vessels due to collision or uncontrolled well flow of hydrocarbons).	Release of fuel oil to sea may impact species within the water column, on the sea surface and in coastal habitats.	Discharge to sea			Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N				Yes	
Medium oil or chemical spill from the MODU,	Release of fuel oil or chemicals to sea may impact species	Discharge to sea			Y	N	Y	Y	Y	N	N	Y	N	N	N				Yes	

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
requiring some intervention (e.g. spillage of LTOBM / diesel / base oil transfer during bunkering operations or from storage tanks/containers).	within the water column, on the sea surface and in coastal habitats.																			
Small oil or chemical spill which will disperse within a few hours to days (e.g. hydraulic fluid, lubes, helifuels etc)	Release of oil or chemicals into the marine environment may affect water quality and species living in the water column and on the sea surface.	Discharge to sea			Y	N	Y	Y	N	N	N	N	N	N	N				Yes	
Other Accidental Events																				
Dropped objects.	Dropped objects may pose a risk to subsea infrastructure or a hazard to other users of the sea.	Seabed Impacts										N	N	N	N				No	
Loss of MODU or support vessel	Presence of wreck on the seabed.	Resource use, socioeconomic, seabed impacts				Y	Y								Y	N			Yes	

Table A3.2: Impact Scoring Matrix 2: Floating Production Storage and Offloading (FPSO) Installation and Commissioning

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
General Operations																				
Fuel use during FPSO installation operations.	Use of diesel for power generation.	Resource use														N	N	N	No	
Resource use during installation operations.	The single use of various resources during installation operations, including furniture, stationary, electrical equipment, steel, refrigerants and radioactive substances will be required.	Resource use														N	N	N	No	
Positioning and presence of infrastructure (anchors) on the seabed	Physical impact FPSO anchors on the seabed will have the potential to affect benthic communities.	Seabed Impacts			N	Y	N	N	N										Yes	Suction anchors to be used when installing the FPSO
Positioning of infrastructure (anchors) on the seabed	Temporary storage of FPSO anchor lines on the seabed prior to the FPSO arriving on site	Physical Presence			N	Y	N	N	N										Yes	Anchor lines may be wet stored prior to FPSO arriving on location (may be placed on the seabed for up to 1 year before the FPSO arrives for hookup)
Fix infrastructure (suction anchors) to the seabed	Installation of FPSO anchors on seabed will generate noise.	Noise and visual impacts			N	N	N	N	N										No	It is proposed that suction anchors will be used.
FPSO and support vessels - General noise and vibration of equipment whilst operating (below sea level)	Production of sound below sea level (e.g. from thrusters) will cause underwater noise.	Noise and visual impacts			N	N	Y	N	Y										Yes	
Helicopters - General noise and vibration of equipment whilst operating (on sea surface)	Production of sounds on the sea surface (including transfer routes) will cause noise in the air.	Noise and visual impacts			N	N	N	N	N										No	
Lighting during operations	Artificial light is emitted from vessels and may attract birds.	Noise and visual impacts			N	N	N	N	N										No	
Production Operations																				
Ongoing presence of FPSO	Potential for the FPSO to be a navigation hazard.	Physical Presence										Y	Y	N	N				Yes	

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
Lighting during operations	Artificial light is emitted from vessels.	Noise and visual impacts			N	N	N	N	N										No	
Ongoing presence of anchors	Physical presence of FPSO anchors on seabed will have the potential to affect benthic communities and fishing.	Physical Presence			N	Y	N	N	N			Y	N	N	N				Yes	
Ongoing presence of anchor lines	Physical presence of FPSO anchor lines on seabed will have the potential to affect benthic communities and fisheries.	Physical Presence			N	Y	N	N	N			Y	N	N	N				Yes	
Discharge and Emissions																				
FPSO Installation / Commissioning																				
Atmospheric emissions during installation and commissioning.	Energy generation during installation and operation of the FPSO contribute to atmospheric emissions of greenhouse gases.	Atmospheric emissions	Y	Y															Yes	All impacts related to atmospheric emissions are automatically scoped in.
Initial flaring during commissioning and start-up	Combustion of flare gas and hydrocarbons results in emissions of greenhouse gases to the atmosphere.	Atmospheric emissions	Y	Y															Yes	All impacts related to atmospheric emissions are automatically scoped in.
FPSO and support vessels - Discharge of domestic sewage	Sewage has high BOD resulting from organic and other nutrient matter in the detergents and human wastes.	Discharge to sea			N	N	N	N	N										No	
FPSO and support vessels - Release of food waste to sea	Waste has high BOD resulting from organic and other nutrient matter. Positive impact of nutrients provided for fish.	Discharge to sea			N	N	N	N	N										No	
Discharge of ballast water	Potential to introduce alien species.	Discharge to sea			Y	Y	Y	N	N										Yes	
Production Operations																				
Discharge of treated seawater during start-up	Discharge of treated seawater containing chemicals into the marine environment may affect water quality.	Discharge to sea			N	N	N	N	N										No	
Discharge of produced water during ongoing production / discharge of reservoir oil contaminated fluids	Discharges containing chemicals and oil into the marine environment may affect water quality.	Discharge to sea			Y	N	Y	N	N										Yes	

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
during maintenance and well intervention (will include produced chemicals)																				
Produced sand discharge	Discharges containing sand into the marine environment may affect water quality.	Discharge to sea			N	N	N	N	N										No	Fine sand will be produced through sand screens. Sand will require to be cleaned and treated. Any residual hydrocarbon to be less than 1% weight
Atmospheric emissions from diesel and fuel use by FPSO.	Energy generation during operation of the FPSO contribute to atmospheric emissions of greenhouse gases.	Atmospheric emissions	Y	Y															Yes	All impacts related to atmospheric emissions are automatically scoped in.
Non-routine flaring	Combustion of flare gas and hydrocarbons also results in emissions of greenhouse gases to the atmosphere.	Atmospheric emissions	Y	Y															Yes	Gas to be exported via pipeline. All impacts related to atmospheric emissions are automatically scoped in.
Greenhouse gas (GHG) emissions associated with the transportation, distribution and processing (refining) and end user combustion of hydrocarbons produced from the proposed Cambo field development	Scope 3, Category 9, 10 and 11 emissions, based on full combustion of all produce Cambo hydrocarbons	Atmospheric emissions	Y	Y															Yes	All impacts related to atmospheric emissions are automatically scoped in.
Waste																				
General operational waste - Hazardous	Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	Solid waste														N	N	N	No	Waste management section to be included in ES in line with recent comments from OPRED.

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fisheries	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
General operational waste - Non hazardous	Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	Solid waste														N	N	N	No	Waste management section to be included in ES in line with recent comments from OPRED.
Emergencies / Accidental Events																				
Large Release																				
Large oil spill, requiring mobilisation of all available internal and external oil spill response resources (e.g. fuel oil spillage from FPSO ' installation vessels / support or supply vessels due to collision; or loss of FPSO inventory).	Release of fuel oil or hydrocarbon inventory to sea may impact species within the water column, on the sea surface and in coastal habitats.	Discharge to sea			Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N				Yes	
Medium oil or chemical spill, requiring some intervention (e.g. spillage of chemicals / diesel / other oils during bunkering operations and storage).	Release of chemicals or fuel oils to sea may impact species within the water column and on the sea surface.	Discharge to sea			Y	N	Y	Y	Y	N	N	Y	N	N	N				Yes	
Small oil or chemical spill which will disperse within a few hours to days (e.g. hydraulic fluid, lubes, helifuels etc)	Release of fluids to sea may impact species within the water column and on the sea surface.	Discharge to sea			Y	N	Y	Y	N	N	N	N	N	N	N				Yes	
Other Accidental Events																				
Dropped objects.	Dropped objects may pose a risk to subsea infrastructure or a hazard to other users of the sea.	Seabed impacts										N	N	N	N				No	
Loss of installation vessels, support vessels or FPSO.	Presence of wreck on the seabed.	Resource use, socioeconomic, seabed impacts				Y	Y								Y	Y			Yes	

Table A3.3: Impact Scoring Matrix 3: Subsea and Pipeline Installation and Operation

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fishery	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
General Operations																				
Installation Operations																				
Presence of installation and support vessels	Potential for the vessels to be a navigation hazard.	Physical Presence										N	N	N	N				No	
Fuel use during FPSO installation operations.	Use of diesel for power generation.	Resource use														N	N	N	No	
Resource use during installation operations.	The single use of various resources during installation operations, including furniture, stationary, electrical equipment, steel and refrigerants will be required.	Resource use														N	N	N	No	
Laying of flowlines infield	Physical impact of flowlines and umbilicals on the seabed will have the potential to affect benthic communities.	Seabed Impacts			N	Y	Y	N	N										Yes	Infield pipelines will be surface laid.
Laying of gas export line deepwater (outwith infield area)	Physical impact of pipeline on the seabed will have the potential to affect benthic communities.	Seabed Impacts			N	Y	Y	N	N										Yes	
Positioning of infrastructure on the seabed (infield)	Physical impact of manifolds / drill centres / SDC on seabed will have the potential to affect benthic communities.	Seabed Impacts			N	Y	Y	N	N										Yes	
Fix infrastructure to the seabed (infield)	Installation of manifolds / drill centres on seabed will cause underwater noise.	Noise and visual impacts			N	N	N	N	N										No	No driven piles, suction piles to be used instead.
Laying of concrete mattresses, grout bags etc for protection of flowlines or other infrastructure	Laying of pipelines flowlines and umbilicals on the seabed will have the potential to affect benthic communities.	Seabed Impacts			N	Y	N	N	N										Yes	Anticipate crossovers for SHEFA2 cable and other potential obstructions along the pipeline route.
Installation and support vessels - General noise and vibration of equipment whilst operating (below sea level)	Production of sound below sea level (e.g. from thrusters) will cause underwater noise.	Noise and visual impacts			N	N	Y	N	Y										Yes	
Lighting during operations	Artificial light is emitted from vessels and may attract birds.	Noise and visual impacts			N	N	N	N	N										No	

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fishery	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
Production Operations																				
Inspection, maintenance and repair of pipelines / flowlines / subsea infrastructure on the seabed	Physical presence of infrastructure on seabed will have the potential to affect benthic communities.	Physical Presence			N	N	N	N	N			N	N	N	N				No	
Presence of pipelines / flowlines / subsea infrastructure / anchors and anchor lines in wet storage on the seabed prior to production commencing	Physical presence of infrastructure on seabed will have the potential to affect other users of the sea.	Physical Presence										N	N	N	N				No	
Ongoing presence of pipelines / subsea infrastructure on the seabed	Physical presence of infrastructure on seabed will have the potential to affect benthic communities.	Physical Presence			N	N	N	N	N										No	
Discharge and Emissions																				
Installation Operations																				
Use and discharge of chemicals during testing and commissioning of flowlines	Discharge of chemicals, including those used during riser connections and commissioning, domestic chemicals, fire protection system, laboratory may affect water quality.	Discharge to sea			N	N	N	N	N										No	
Atmospheric emissions during installation and commissioning.	Energy consumption during installation will contribute to atmospheric emissions of greenhouse gases.	Atmospheric emissions	Y	Y															Yes	All impacts related to atmospherics are automatically scoped in.
Installation vessels - Discharge of domestic sewage	Sewage has high BOD resulting from organic and other nutrient matter in the detergents and human wastes	Discharge to sea			N	N	N	N	N										No	
Installation vessels - Release of food waste to sea	Waste has high BOD resulting from organic and other nutrient matter. Positive impact of nutrients provided for fish	Discharge to sea			N	N	N	N	N										No	
Discharge of ballast water from installation vessels	Potential to introduce alien species.	Discharge to sea			Y	Y	Y	N	N										Yes	
Discharge of slops	Discharge of slops including seawater with MEG may affect water quality.	Discharge to sea			N	N	N	N	N										No	Seawater with MEG recovered from flowlines during commissioning

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fishery	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
																				could potentially be discharged with slops (permitted via MAT/SAT).
Production Operations																				
Use and discharge of hydraulic fluids subsea during ongoing production	Discharge of chemicals into the marine environment may affect water quality.	Discharge to sea			N	N	N	N	N										No	An open loop system will be used.
General Operational Waste																				
General operational waste from installation vessels	Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	Solid waste														N	N	N	No	Waste management section to be included in ES in line with recent comments from OPRED. Hazardous waste not scored as no hazardous waste expected.
Emergencies / Accidental Events																				
Large oil spill, requiring mobilisation of all available internal and external oil spill response resources (e.g. fuel oil spillage from installation vessels / support and supply vessels due to vessel collision or catastrophic loss of flowline / riser inventory).	Release of fuel oil or hydrocarbons to sea may impact species within the water column, on the sea surface and in coastal habitats.	Discharge to sea			Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N				Yes	
Medium oil or chemical spill, requiring some intervention (e.g. spillage of chemicals / diesel / other oils during installation or bunkering operations and storage).	Release of chemicals or fuel oil into the marine environment may affect water quality and species living in the water column.	Discharge to sea			Y	N	Y	Y	Y	N	N	Y	N	N	N				Yes	

Description of Aspect		Environmental Issue	Atmosphere		Biological Receptors					Sensitive Features		Other Users of the Sea				Societal			Scoped in for further assessment	Comments
Operational Activity (Source)	Impact (Pathway)		Local air pollution	Global warming potential	Plankton	Benthos	Fish/Shellfish	Seabirds	Marine mammals	Offshore Conservation Area	Inshore Conservation Area	Commercial fishery	Shipping	Military activity	Infrastructure	Resource use	General public	Recreation		
Small oil or chemical spill which will disperse within a few hours to days (e.g. hydraulic fluid, lubes, helifuels for example during pigging)	Release of fluids to sea may impact species within the water column and on the sea surface.	Discharge to sea			Y	N	Y	Y	Y	N	N	Y	N	N	N				Yes	
Other Accidental Events																				
Dropped objects.	Dropped objects may pose a risk to subsea infrastructure or a hazard to other users of the sea.	Seabed impacts										N	N	N	N				No	
Loss of installation vessels, or support vessels.	Presence of wreck on the seabed.	Resource use, socioeconomic, seabed impacts				Y	Y								Y	Y			Yes	

A.4 Summary of Scoping Feeback

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	Alternatives to the proposed project should be discussed and environmental impacts compared. Where there is more than one option then sufficient detail for each will be required within the ES to enable a full assessment of each option (3.2.2 [EIA Guidance]). For example, it is currently proposed that the FPSO anchor moorings will be piled into the seabed however it is understood that the nature of the soils at the Cambo location may lend themselves to suction anchors and where doubt exists the ES should discuss both options. Similarly, where the Can-ductor may be used for the Cambo wells this should be considered as an option within the ES.	Project options have been presented in the ES. Survey data has confirmed that piling for infield infrastructure is not required; suction anchors to be utilised. Both conventional drilling and use of CAN-ductors are assessed in the ES.	Project options have been considered in the ES in Section 3 (Option Selection). Where certain options have not been wholly confirmed, the impact assessment considered the option which presents the "worst-case scenario" for impacts.	Section 3 Section 8 - 14
OPRED	Where the development is to be carried out in stages then the full extent of proposals should be described (3.2.3 and 3.2.6 [EIA Guidance]).	Cumulative impacts have been included in each impact section.	The full extent of the proposed Cambo field development has been assessed in the ES.	Section 8 to Section 14
OPRED	Gas export pipeline – while it is understood that the export pipeline gradient (~1000m to 200m depth) does not pose any technical challenges for single phase hydrocarbons (gas), the future pipeline use should be considered i.e. if gas condensates are anticipated to be exported via this pipeline then this should be considered in the ES.	The 10" gas export pipeline offers capacity above the requirements for Cambo Phase 1 alone, and so is consistent with MER UK obligations towards other Field developments. The new pipeline ties into the existing West of Shetland Pipeline System (WOSPS) to Sullom Voe - this system is a single-phase gas system, and so no gas condensates are anticipated to be exported.	The revised gas export pipeline no longer traverses the Faroe-Shetland Sponge Belt MPA but instead transits northeast towards the planned Rosebank gas export system. This system is a single-phase gas system, and so no gas condensates are anticipated to be exported.	Section 3 Section 4 Section 8

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	It is understood that the Cambo oil is likely to have some waxing properties but that these are expected to be low. SPE[1] are advised to consider the likelihood of pipeline waxing within the ES and any implications this may have along with any mitigation required. In particular any effects that may be caused by reduction in temperature between the well and the flowlines.	Significant wax deposition is not expected to occur based on an analysis of 2018 well test fluids. Subsea infrastructure will be designed to maintain operating temperatures above the wax appearance temperature (through passive insulation), and provisions are made in the design to allow hot oil flushing and round-trip pigging for wax management. Specifically, for the wells to production manifolds / main flowlines, individual well jumpers will also be insulated, and facilities provided for flushing via the Xmas trees.	The position from 2021 remains.	N/A
OPRED	As per Marine Scotland comments with respect to the infield survey it is advised that, in addition to ROV survey, grab samples for physio/chemical and benthos are taken to update baseline data for the Cambo area. This can be used to support existing survey information, some of which is >5 years old (3.6.1 and 3.6.2 [EIA Guidance]).	Grab samples were taken during an environmental baseline survey in 2018.	Grab samples were collected during an environmental baseline survey undertaken in 2025.	Section 5

[1] Please note operatorship has changed from Siccar Point Energy (SPE) to Ithaca Energy since the receipt of stakeholder feedback for the previous ES submissions.

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	The Department is aware that SPE and JNCC are to discuss the survey requirements in relation to the export pipeline route through the Faroe-Shetland Sponge Belt NCMPA. During the scoping meeting it was concluded that ROV video and photographs would be sufficient to form the basis of the impact assessment for the ES. SPE are however reminded that the full survey results will be required to inform future PETS applications and that both qualitative and quantitative assessment is required.	Comment noted. The survey results are presented in the ES and will be used to support future PETS applications.	The revised gas export pipeline route no longer traverses the Faroe Shetland Sponge Belt NCMPA. New survey data collected in 2025 is presented to describe the baseline environment along the revised pipeline route and will be used to support future PETS applications.	Section 4 Section 5
OPRED	Routine chemical use and discharge to sea during operation do not need to be assessed within the ES but they should be acknowledged and an overview of how this will be managed incorporated in the ES i.e. MAT/SATs.	Use of chemicals has been included at a high level in the ES where relevant. More details information on chemical use and discharge will be included in future PETS applications / environmental permitting process.	Use of chemicals has been included at a high level in the ES where relevant. More details information on chemical use and discharge will be included in future PETS applications / environmental permitting process.	Section 11
OPRED	With regard to produced water it is noted that the intention is to discharge overboard. SPE should note the OPRED expectation is for the re-injection produced water where practicable. Where not technically possible/desirable then a robust justification for not injecting must be provided. In the event that there is overboard discharge of produced water SPE should note that OiW limit is likely to be less than 30mg/l and the produced water treatment system should be designed to achieve as low a concentration as practicable in line with the principles of BAT.	Rationale for the decision to manage disposal of produced water through overboard discharge is included in the ES. Produced water dispersion modelling was also undertaken with results presented in this ES.	Rationale for the decision to manage disposal of produced water through overboard discharge is included in the ES. Updated produced water dispersion modelling has been undertaken to reflect change in the project design (e.g. the change to a ship shape FPSO from a sevan FPSO) with the results presented in this ES.	Section 3 Section 4 Section 11

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	In order to support any conclusions on the impact of drilling discharges relevant modelling should be provided and any discharges of cement should be minimised and fully justified.	Drill cuttings discharge modelling has been undertaken.	Updated drill cuttings modelling has been undertaken which includes recent OPRED requests to include respudding of wells and sidetracks mirroring the WONS consent.	Section 4 Section 10
OPRED	If well testing may be undertaken, then this should be scoped in.	A well test was undertaken in 2018 when appraisal well 204/10a-5 was drilled.	No well test operations are proposed.	Section 3 Section 4
OPRED	MODU, Infrastructure installation activities and FPSO combustion emissions should be scoped in.	Atmospheric emissions have been assessed.	Atmospheric emissions have been assessed and include Scope 3 emissions in line with recent guidance issued by OPRED.	Section 9
OPRED	It is noted that the installation of a gas export line is the preferred option. However, if any extended flaring of gas is proposed then this should be discussed within the ES.	There will be no extended flaring of gas from Cambo.	There will be no extended flaring of gas from Cambo	Section 4
OPRED	Any venting of unburned hydrocarbons should be scoped into the ES.	There will be no routine cold venting from the Cambo facilities. Low volume, non-routine venting may be necessary from time to time in readiness for maintenance e.g. hydrocarbon freeing in preparation for cargo tank entry.	There also will be no routine venting of unburnt hydrocarbons however venting systems will be installed to safely manage non-routine operations such as process start-ups, upsets and emergencies. Venting from cargo tanks will normally be recovered by the Vapour Recovery Unit (VRU) and routed to LP compression.	Section 4

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	Noise emissions from the FPSO and MODU should be considered. Where piling is required then this should also be scoped in. Similarly, if there is any seismic activity to be undertaken such as Vertical Seismic Profiling then this should also be scoped in. Please note that new injury thresholds for marine mammals were published in 2016 (NOAA, 2016), updating those published in Southall et al 2007. JNCC (and the other SNCBs) are currently considering these new guidelines and how they may be incorporated into marine mammal noise assessments, however it is likely JNCC will be formally endorsing these new thresholds/hearing functions in 2018 and therefore it is recommended these are incorporated into future assessments. http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm	Noise emissions are assessed within the ES.	The potential impacts from underwater noise on receptors has been considered in the ES and assessed accordingly.	Section 12
OPRED	It is noted that the gas export pipeline is to be laid on the seabed with minimal rock dumping. The route and intended method of pipeline installation should be justified in the ES and the Department would emphasise that any rock deposits should be the minimum necessary to achieve the required protection/stability of the pipeline. The worst-case rock deposits should be discussed within the ES.	Rock dumping may be required, and conservative estimates have been included in this ES and potential impact assessed accordingly.	Rock placement is no longer required. A small number of concrete mattresses may be required at cable crossing points and potential impact assessed accordingly in this ES.	Section 4 Section 8

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	The presence of the FPSO and 2 x production centres (and the temporary presence of MODU and support vessels) should be scoped in as per Section 3.2.6 and 3.4.3.4 of the EIA guidance. Where it is intended that there are additional 500m safety zone around production centres, wellheads etc then these should also be scoped into the ES.	Details of all relevant infrastructure, FPSO and support vessels have been included in the ES.	Details of all relevant infrastructure, FPSO and support vessels have been included in the ES.	Section 4
OPRED	Both MODU and FPSO anchor impact need to be assessed, in addition to the disturbance impact of the other infrastructure. This should include the worst-case number of FPSO anchors.	A DP MODU will be used for Cambo. FPSO anchor impact has been assessed in the ES.	A dynamically positioned MODU and / or drill ship will be used to drill the wells at the Cambo field development. Potential impacts from the FPSO anchors have been considered in the ES.	Section 4 Section 8
OPRED	Dropped objects may pose a hazard to fishing activities and SPE[1] should consider if this needs to be addressed in the ES.	Impacts resulting from dropped objects were not considered significant during the ENVID and therefore not assessed further.	Impacts resulting from dropped objects were not considered significant during the ENVID and therefore not assessed further.	NA
OPRED	Consideration should be given to cumulative effects e.g. potential impacts upon Faroe-Shetland Sponge-Belt NCMPA (3.2.12 [EIA Guidance]).	Cumulative effects upon the NCMPA are addressed in the ES.	The gas export pipeline no longer traverses the Faroe-Shetland Sponge-Belt NCMPA. Potential impacts on this protected area are considered where relevant (i.e. Accidental Events).	Section 14
OPRED	The risk and potential impact of failure of operational equipment or control systems, the precautions to prevent these occurring and a description of how these will be managed should be provided (3.2.6 and 3.2.10.2 [EIA Guidance]).	Preventative measures to reduce risk & potential impact of such failures are addressed under Accidental Events.	Preventative measures to reduce risk & potential impact of such failures are addressed under Accidental Events.	Section 14

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	A MEI assessment will be required which incorporates the worst-case well blowout and total FPSO inventory (3.2.10 [EIA Guidance]).	An MEI assessment has been provided in the ES.	An MEI assessment has been provided in the ES.	Section 14
OPRED	Section 4.4 of the Scoping Study states that the $250 million OPOL cover limit per incident is sufficient for most wells with only a small number of wells having the potential to exceed this. It is understood that none of the Cambo wells have the potential to exceed the OPOL limit but confirmation of this should be included.	For the 2018 Cambo Appraisal Well (considered a high performing well) it was established that clean-up and 3rd party liability would be covered by the OPOL Limit.	Clean-up and 3rd party liability would be covered by the OPOL Limit.	Section 14
OPRED	The ES will need to consider natural disasters (at a high level) as per Section of 3.2.10.2 of the EIA Guidance.	No such natural disasters are anticipated or considered likely to have an environmental impact. Seismic activity is very low in and around the Cambo Project area. This suggests the likelihood of a major accident due to an earthquake or associated tsunami is extremely remote. In addition, the FPSO mooring system and hull structure has been designed to withstand 10,000-year extreme weather events.	Natural disasters are considered in the ES.	Section 14
OPRED	Waste - while detailed information is not required, wastes and waste management should be described at a high level.	Waste has been included in the ES.	A section on waste and waste management is included in the ES.	Section 13

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
OPRED	It is noted that there is no reference to decommissioning intentions. While there are no requirements to provide detailed information at the ES stage, higher level considerations/design intentions should be addressed in line with Section 3.2.10.2 of the EIA guidance.	Decommissioning is addressed at a high level in the Project Description.	Decommissioning is discussed at a high level in the Project Description.	Section 4
Marine Scotland	It is questioned whether a Non-Technical Summary will be provided in the ES?	A Non-Technical Summary has been provided.	A Non-Technical Summary has been provided.	NTS
Marine Scotland	It is advised that a summary table of feedback received from stakeholders is included in the ES and detail provided as to how any feedback been addressed.	Feedback from stakeholders and information on how comments have been addressed are included in the ES.	Feedback from stakeholders and information on how comments have been addressed are included in the ES. This has been updated to reflect changes in the project design since submission of the ES.	Section 6 Appendix 4
Marine Scotland	Marine Scotland would ask that an option selection and alternatives section is included in the ES which should discuss why the proposed development (including pipeline option) is the best available option.	Options have been addressed in the ES.	The ES contains an Option Selection chapter which outlines key project alternatives considered.	Section 3

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	Marine Scotland note that a significant ~60 km gas export pipeline is being considered which transits through the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA). Given the proximity of other proposed developments (such as Rosebank and Black Rock) and the likely future oil and gas expansion in the West of Shetland region, Marine Scotland would urge Siccar Point Energy to adopt a strategic approach for proposed pipelines by exploring all opportunities for sharing trunk lines, building in adequate capacity to accommodate future developments and considering all alternative routes in order to minimise any impact on the Faroe-Shetland Channel NCMPA. The ES should demonstrate that the chosen option represents Best Environmental Practice (BEP) using Best Available Technology (BAT) and takes account of decommissioning.	Justification for the pipeline route has been included in the ES.	The revised gas export pipeline route no longer traverses the Faroe Shetland Sponge Belt NCMPA. Instead, the gas export pipeline is proposed to connect to the Rosebank gas export pipeline at the Cambo gas export pipeline (GEP) in line tree (ILT). Survey data along the proposed pipeline route has been collected and is presented in the ES.	Section 4 Section 5
Marine Scotland	A detailed schedule of works should be provided with any contingency periods clearly stated.	An indicative schedule of activities to first oil has been provided in the ES.	An updated, indicative schedule of activities to first oil has been provided in the ES.	Section 4
Marine Scotland	It is advised that cementing operations are detailed and associated environmental/socio economic impacts assessed in the ES.	Anticipated quantities of cement slurry, for a conventional well design, have been included in the ES and assessment accordingly.	Anticipated quantities of cement slurry, for a conventional well design, have been included in the ES and assessment accordingly.	Section 10

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	It is understood that the base case for new developments should follow the requirements of OSPAR 2001/1 (i.e. zero discharge of oil in produced water). It is therefore advised that any deviation from this position is fully justified and based on a BAT/BEP approach. Will the proposed hydrocarbon production profiles and produced water profiles be included in the ES?	The decision to discharge produced water and justification for doing so is provided in the ES. Production profiles are also provided in summary, up front in the ES, and in more detail in an appendix to the ES.	The decision to discharge produced water and justification for doing so is provided in the ES supported by updated modelling of produced water discharges. Updated production profiles are also provided in summary, up front in the ES, and in more detail in an appendix to the ES.	Section 3 Section 4 Section 11 Appendix 5
Marine Scotland	The detailed assessment of chemical usage will correctly be deferred to the chemical permitting stage, however, given that produced water is to be discharged from this development, and given the waxy nature of the crude (as highlighted in the scoping meeting on 23 March 2018) an upfront overview of any potential concerns from a chemical discharge perspective, is advised.	Chemical discharges are assessed in relation to drilling activities and acknowledged in relation to produced water discharge.	Chemical discharges are assessed in relation to drilling activities and acknowledged in relation to produced water discharge.	Section 10 Section 11

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	Marine Scotland welcome that a number of surveys have been conducted in this area but note that the last comprehensive survey (comprising grab sampling methodologies) was in 2001 which is now 17 years old. Future site surveys were discussed in the scoping meeting on 23 March 2018 and it is understood that a full baseline environmental survey is to be undertaken along the proposed pipeline route. The design of this survey is to be discussed further with representatives from the Joint Nature Conservation Committee (JNCC), which is welcomed. It is understood that an ROV survey is also proposed for the infield area. Marine Scotland highlighted during this meeting that given the age of the existing data, there would be benefit from collecting additional in-field grab samples to further demonstrate stability in the environment and enable a quantified analysis of infauna and physio-chemical properties to update baseline data from which to measure the impacts of the operation when it comes to decommissioning.	SPE[1] met with the JNCC to discuss plans for the environmental baseline survey in detail. Results from the survey have been included in the ES Environmental Description.	A further EBS was undertaken in 2025 and the results from that survey are presented in the ES.	Section 5
Marine Scotland	It is advised that the extent of the mapped geo-morphological features is shown in relation to the proposed development and in particular the proposed pipeline route. The following page would be useful in demonstrating this: (http://jncc.defra.gov.uk/page-5201)	Seabed features and bathymetry of the proposed development area have been included in the ES.	Seabed features and bathymetry of the proposed development area have been included in the ES.	Section 5
Marine Scotland	A local scale bathymetry map for the development area is advised, highlighting any significant seabed features.	As above.	As above.	Section 5

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	Marine Scotland has recently added new spatial layer to the NMPi, which show predicted seabed habitats and sediment types (at 1:25,000 scale) which the author may find useful. Presenting this visually in the ES would give useful wider scale context. These spatial layers may be viewed on the National Marine Plan interactive (NMPi): http://www.gov.scot/Topics/marine/seamanagement/nmpihome.	Sediments are addressed in the ES and a sediment data map has been included in the Environmental Description, this follows BGS NERC 2018, which can be found on NMPi.	An updated figure showing revised project infrastructure in relation to predicted seabed sediments is included in the ES	Section 5
Marine Scotland	Good quality, high resolution images of the local sediment/benthic community, clearly linked to a map showing the location of the photographs, would be a useful addition.	Images from the 2018 survey have been provided in the Environmental Description.	Images from the 2025 survey have been provided in the Local Environment section of the ES.	Section 5
Marine Scotland	A summary of any contaminant analysis should be provided.	A summary of contaminant analysis is presented in the ES.	A summary of contaminant analysis is presented in the ES.	Section 5
Marine Scotland	Where species of conservation concern or species indicative of habitats of conservation concern are identified, it is advised that the abundance of animals is discussed per unit area (m^2).	Abundance has been addressed in the Environmental Description.	Where data permits, abundance has been provided in the Local Environment section of the ES.	Section 5
Marine Scotland	Marine Scotland agree with sources of information to assess the spawning and nursery sensitivities in the area and acknowledge that the area is not highlighted by the cited literature as being of particular importance as a fish spawning area.	Comment noted.	Comment noted.	NA
Marine Scotland	Marine Scotland welcome that deep sea/mesopelagic species have also been included but also acknowledge that information regarding such populations is limited.	Comment noted.	Comment noted.	NA

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	It is advised that spurdog are also listed a Priority Marine Feature (PMF) species. These are listed a 'spiny dogfish' in the PMF list.	Reference to spurdog has been made in the Environmental Description.	The revised gas export pipeline route no longer passes through a predicted nursery area for spurdog, Consequently, this species is no longer referenced in the ES.	Section 5
Marine Scotland	Marine Scotland has commissioned the Sea Mammal Research Unit at the University of St Andrews to provide updated maps showing the distribution of grey and harbour seals around the UK. These 'usage' maps are produced by looking at movement patterns from electronically tagged seals. The resulting patterns of usage are scaled to population levels using data collected in aerial survey counts at haul out sites, to produce estimates of mean density (seals per 5x5 km grid cells). These maps are an update of the previous seal usage maps described in Jones et al. (2015) and it is advised these are referred to in the ES. The maps are available to view on NMPi (https://marinescotland.atkinsgeospatial.com/nmpi/) and further information is available here (http://www.marine.gov.scot/node/12697).	Up to date At-Sea Grey and Common Seals population in the vicinity of the proposed field development are addressed in the Environment Description.	Data on seal distribution at sea is presented using information from Carter et al. 2025.	Section 5
Marine Scotland	Marine Scotland agree with the conservation areas highlighted and welcome that these are shown in a well-produced map.	A conservation areas map has been included in the ES.	A conservation areas map has been included in the ES.	Section 5
Marine Scotland	Marine Scotland agree with the general findings of this section that fishing activity by UK vessels is not significant in this area with fishing effort focused more on shelf areas to the south and west.	Comment noted.	Comment noted.	NA

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	Marine Scotland would recommend using the following maps available on NMPi to show effort, landings and value for the last five years; 1. tonnage for demersal, pelagic and shellfish species; 2. value (£) for demersal, pelagic and shellfish species; 3. effort (days) (by UK vessels >10 m length) for demersal active (bottom trawls, dredges etc.); pelagic active (pelagic trawls, purse seines etc.); and passive (pots/creels, gillnets etc.). Further details are available here: http://marine.gov.scot/node/12674 The above spatial layers may be viewed on NMPi and it is recommended these are represented visually: http://www.gov.scot/Topics/marine/seamanagement/nmpihome.	Graphics and maps showing tonnage, value and effort have been included in the ES.	Updated figures and tables detailing landings, value and effort for commercial fisheries have been presented in the ES. Where applicable, data covers a 10 year period as requested by OPRED.	Section 5
Marine Scotland	Representing fisheries statistics in a tabular format in addition to the above is also recommended.	As above.	As above.	Section 5
Marine Scotland	The section states that “foreign vessels spent up to 6 months fishing in rectangle 50E6. This data also indicated that foreign vessels spent under one week in the Cambo Phase 1 Development rectangle (59E5)”. It is advised that year this information relates to is highlighted (2012).	Comment noted. Commercial fisheries within relevant ICES areas have been addressed in the ES.	An update to commercial fishery activity has been provided in the ES.	Section 5

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	A couple of anomalies are present in the report, as follows: * Data from 2016 (for ICES 50E6) only shows landings for Jan and May not January, April and June? * Demersal active gear effort between 2012 and 2016 was 162.5 days not 165 days? * The total sales value between 2010 and 2016 (from 50E6) was £4,132,785 not £4,106,026? * The total shellfish sales value between 2010 and 2016 (from 50E6) was £16,990 not £12,000?	Anomalies acknowledged. Data has been revisited for the ES and provided for 2012 to 2016.	Commercial fisheries statistics have been updated and are presented in the ES.	Section 5

Marine Scotland	Fishing measures within MPAs – the Marine and Coastal Access Act 2009 requires management action to be taken to ensure that achievement of the conservation objectives of the 13 Offshore MPAs is not hindered. These MPAs are considered necessary to comply with Article 13(4) of the EU Marine Strategy Framework Directive. The Common Fisheries Policy permits vessels from other member states, and also third countries like Norway, to fish in Scottish waters. Therefore, when fisheries management measures are required to protect offshore sites, member states must submit a proposal for measures to the European Commission (EC). This process involves working with other member states who have a direct management interest to develop suitable management proposals. Marine Scotland and JNCC have engaged with stakeholders through a number of workshops to discuss management proposals for Scotland's offshore MPAs and recommendations have now been made for fishery management measures within these areas (including the Faroe-Shetland sponge belt MPA). It can be seen in the attached timeline documentation that implementation of the measures by the EC, through a delegated Act, was due on 31/1/18, however, this now expected to be towards the end of 2018. Further developments will be published on our website as information becomes available and it is advised that it would be useful to highlight the proposed management measures in the ES. More detail on the proposals submitted to the EC can be obtained here: http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/SACmanagement	Management measures are acknowledged within the Environmental Description.	The proposed Cambo development footprint no longer transits through the Faroe-Shetland Sponge Belt NCMPA. The Local Environment section of the ES has been updated to reflect the revised project plan.	Section 4 Section 5

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	Of particular relevance (to the Faroe Shetland Sponge belt) are the documents on the following page concerning the Northern North Sea Proposal: http://www.gov.scot/Topics/marine/marine-environment/ mpanetwork/SACmanagement/Offshore2017	Comment noted.	The proposed Cambo development footprint no longer transits through the Faroe-Shetland Sponge Belt NCMPA. The Local Environment section of the ES has been updated to reflect the revised project plan.	Section 4 Section 5
Marine Scotland	Map layers showing these proposed areas are now available on Marine Scotland's National Marine Plan interactive (NMPi) which may be accessed here: https://marinescotland.atkinsgeospatial.com/ nmpi/. The relevant layer may be found by following the following hierarchy on NMPi: Healthy and biologically Diverse, Protected Areas, Marine Protected Areas (MPA) Network, Marine and Nature Conservation management in Marine Protected Areas (MPA) Network, Possible Marine Conservation Orders (MCO's) and fishery management measures for consultation (MPA and SAC's) June 2017.	Comment noted.	The proposed Cambo development footprint no longer transits through the Faroe-Shetland Sponge Belt NCMPA. The Local Environment section of the ES has been updated to reflect the revised project plan.	Section 4 Section 5

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	Marine Scotland welcome that use of the area by foreign fishing vessels is being considered and have advised previously that anecdotal information regarding foreign fishing activity, from sources such as the Scottish Fishermen's Federation (SFF), is useful to capture foreign fishing vessel activity in this area. Further information is also available via ICES (http://www.ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx). The data set is rather large, given that it covers all member states, but it is possible to ascertain what fish have been landed from the ICES area in question. The issue is likely to be that the data is aggregated based on an area which is quite large, so may not provide the level of detail that the UK statistics provide. Using the ICES spatial facility http://gis.ices.dk/sf/ you can see that Shetland falls within ICES division 27.4a for example, you can then open the 'Official Nominal Catches 2006 – 2015' Excel spread sheet on the right-hand side of this page http://www.ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx and search for landings associated with area 27.4a.	Comment noted. This has been discussed in Section 4.	Updated information on foreign fishing activity is presented in the ES.	Section 5

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	The location of aquaculture sites and Shellfish Water Protected areas would benefit from being shown visually. The following information sources would be useful in demonstrating this: • The National Marine Plan interactive (https://marinescotland.atkinsgeospatial.com/nmpi/); • Scotland's Aquaculture website (http://aquaculture.scotland.gov.uk/map/map.aspx); • The Scottish Shellfish Farm Production survey 2016 (http://www.gov.scot/Publications/2017/05/6435) (These statistics are usually published in May each year); • The Scottish Finfish Farm Production survey 2016 (http://www.gov.scot/Publications/2016/09/1480) (These statistics are usually published in September each year).	Aquaculture sites are shown visually in the Environmental Description of the ES. The references listed here have been used in Section 4.	Information on aquaculture sites is presented in the ES.	Section 5
Marine Scotland	The location of existing oil and gas infrastructure and previously drilled wells would benefit from being shown in a visual format. The Oil and Gas Authority quadrant maps would be a useful addition (http://data.ogauthority.opendata.arcgis.com/datasets?q=Q&sort_by=relevance).	Details on oil and gas infrastructure in the vicinity of the proposed field development have been included in the ES and presented in a figure.	Details on oil and gas infrastructure in the vicinity of the proposed Cambo field development have been included in the ES and presented in a figure.	Section 5

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	The detailed impact assessment methodology to be used is not detailed in the scoping report, but it is advised that a systematic impact assessment methodology is applied to allow impacts to be ranked. An overview of the method used is advised and an indication of the criteria used to determine whether an impact is 'likely' and whether it is 'significant'. The magnitude of the impacts should be predicted in terms of the deviation from the established baseline conditions, for each phase or element of the proposals.	A methodology section has been included in the ES.	The impact assessment methodology is detailed in the ES.	Section 7
Marine Scotland	Marine Scotland welcome that all impacts will be assessed against Scotland's National Marine Plan.	The proposed Cambo field development has been assessed against the following general Marine Plan objectives and policies: GEN 1, 2, 3 ,4, 5, 6, 9, 10, 11, 12, 13, 14, 18, 19, 20 and 21.	Information on relevant Scottish National Marine Plan policies is presented in the ES.	Section 6
Marine Scotland	Marine Scotland welcome that cumulative impacts are to be discussed.	Also raised by OPRED. Cumulative impacts have been included in each impact section.	Cumulative impacts are presented in each dedicated assessment section and have been updated where relevant.	Section 8 to Section 14
Marine Scotland	Marine Scotland understand that the gas export pipeline is likely to be surface laid. Marine Scotland would expect justification in the ES as to the chosen pipeline installation method. It is advised that the installation method of other pipelines in the vicinity is also highlighted in support of the chosen method.	Pipeline installation methods are provided in the ES.	Pipeline installation methods are presented in the ES.	Section 4

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	It is understood that rock protection may be required for the pipeline and it is advised that the worst-case volumes and locations of protective material are included in the ES.	Some rock dumping / rock protection may be required to provide the pipeline with adequate protection from trawling activities. A worst-case quantity of rock protection has been considered for impact assessment purposes.	The revised project design means that rock placement is no longer required. A small number of concrete mattresses may be required for cable crossings (6 mattresses per crossing). These have been considered in the ES.	Section 4 Section 8
Marine Scotland	It is advised that the local geo-morphological features are also considered when assessing any requirement for protective material and the potential for future free spanning of the pipeline is taken into account.	Where practicable, gas pipeline routing will be refined during detailed design to reduce of the potential for free spans which may pose a potential risk of snagging for fishing gear. Unavoidable spans that present a potential hazard to fishing will be rectified (e.g. rock placement).	The revised project design means that rock placement is no longer required. A small number of concrete mattresses may be required for cable crossings (6 mattresses per crossing). These have been considered in the ES.	Section 4 Section 8
Marine Scotland	Marine Scotland would advise against the use of concrete mattresses outwith the 500 m safety zone due to the potential snagging risk this may pose to towed fishing gear.	No mattresses are proposed outwith the 500 m safety zone.	A small number of concrete mattresses may be required for cable crossings (6 mattresses per crossing). These will be placed at depths where fishing activity is unlikely to occur. The ES considers the impact of the placement of these mattresses on the seabed.	N/A
Marine Scotland	Marine Scotland recommend that the extent of any 500 m safety zone is shown on a figure in relation to the proposed infrastructure and location of protective materials.	Please see Figure 3.8 of the ES.	Please see Figure 4.10 in the ES.	Section 4

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	The use of long (2.5 km) polypropylene ropes in the mooring system of the Floating Production Storage and Offload (FPSO) vessel was discussed in the meeting on 23 March 2018. Marine Scotland highlighted that due to lack of a metallic element, this rope can be evaded by sonar detection. Whilst fishing effort is not considered to be significant in this area, Marine Scotland would ask that this issue is discussed further with the SFF and that appropriate, proportionate mitigation is considered. Marine Scotland have been made aware in the past of transponders being fitted to each mooring line to allow fishing boats to detect the moorings.	Comment noted. This issue will be addressed with mooring system designers in the detailed design phase.	Polyester ropes are proposed for use in the mooring system instead of polypropylene. The design of the mooring system is not yet confirmed. Two different systems are being evaluated; either a reasonably large steel buoy attached 200 m below sea level, or a (metal) midline connector. Both of these would reflect sonar.	N/A
Marine Scotland	Marine Scotland welcome that wells at both production centres will be fitted with fishing friendly structures.	SFF advised that only structures in 'open water' i.e. outwith the 500 m exclusion zone would require fishing friendly protection structures. As structure will be protected by the 500 m exclusion zone no protection is planned.	Fishing intensity studies have indicated that there is no fishing activity in the Cambo in-field area. On this basis, and as exclusion zones will be established around the wells and in-field infrastructure, there are no wellhead protection structures planned.	Section 4
Marine Scotland	It is highlighted that the Feature Activity Sensitivity Tool (FEAST - http://www.marine.scotland.gov.uk/FEAST/) contains useful information regarding pressures on selected features of conservation concern and it is recommended this is incorporated into the ES.	FEAST used in all relevant impact sections.	Where appropriate, the FeAST has been consulted as part of the impact assessment process for the Cambo field development.	Sections 8 – 14

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
Marine Scotland	It is advised that the cumulative footprint of the development is quantified and compared to the area of the NCMPA.	Detailed assessment on seabed take within the NCMPA has been provided in the ES.	The proposed Cambo development footprint no longer transits through the Faroe-Shetland Sponge Belt NCMPA. The footprint of the development is considered as part of the impact assessment.	Section 8
Marine Scotland	The predicted effectiveness of the stated mitigation measures should be made clear, and the ES should demonstrate a firm commitment to implementing the proposed measures, where appropriate, indicating how and when the measures will be implemented and confirming lines of responsibility for ensuring implementation. It is useful to provide a tabulated summary of the mitigation measures which is then taken forward into to the ES.	A commitments register has been included as Appendix 2. Where relevant these commitments will be taken forward in an Environmental Management Plan which will confirm lines of responsibility.	A commitments register has been included as Appendix 2. Where relevant these commitments will be taken forward in an Environmental Management Plan which will confirm lines of responsibility.	Appendix 2
Marine Scotland	It is recommended that the ES considers decommissioning upfront and details how all installed infrastructure/protective material would be removed should this be the policy in place at that time.	Also raised by OPRED. Decommissioning is addressed at a high level in the Project Description.	Decommissioning is addressed at a high level in the Project Description.	Section 4
Marine Scotland	Please ensure the ES contains a comprehensive conclusion summarising the main environmental sensitivities and how these are to be mitigated or why they are not considered to be significantly affected.	A conclusions section has been provided in the ES.	Conclusions sections are provided at the end of each impact assessment section and the ES contains a standalone conclusions section.	Sections 8 - 15

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
JNCC	It would also be beneficial if some form of timescale was attached to the identified impact receptor pathways, for example, is the impact of potential concern expected to occur over the short term, long term, or act only in a cumulative context? Providing this information may help focus the subsequent environmental impact assessment process and ensure that only potentially significant impacts are considered.	The impact assessment methodology addresses Source-Pathway-Receptor Analysis. Only potential significant impacts identified during the scoping process were carried forward for detailed assessment.	Duration of a potential impact is considered as part of the impact assessment methodology.	Section 7
JNCC	As per BEIS guidelines https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/644775/OPRED_EIA_Guidance_-_130917.pdf[1] the ES should outline any realistic alternatives to the proposed Cambo I development. This should include alternative pipeline routes and laying methods, alternative export options, alternative production centres, alternative disposal options for produced water and other waste products etc. The consideration of alternatives should demonstrate how environmental criteria have been considered.	Alternatives / options considered during project planning phases are described in Section 2 of the ES.	Alternatives / options considered during project planning phases are described in Section 3 of the ES.	Section 3
JNCC	Whilst JNCC appreciates that not all of the detailed project design will be finalised at the time of ES submission, JNCC notes that best practice would not be to submit subsequent applications where, for example, stabilisation/protection material requirements are incrementally increased. The worst-case scenario should be assessed in the ES to enable a meaningful assessment of the whole environmental impact of the project to be undertaken.	Worst-case scenarios are assessed throughout the ES.	Worst-case scenarios are assessed throughout the ES.	Section 8 - 14

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
JNCC	It is understood that activities evolve over time and that subsequent stages are often contingent on the outcome of the earlier activities. However, every effort should be made to predict the likely outcome and carry out an assessment on that basis so that all the elements have been assessed and presented in the ES. As such a realistic, worst-case scenario should be considered and reassurances provided that as the project develops the predicted environmental impact will not increase, beyond that which has already been assessed. It would therefore be beneficial for the ES to include project details such as the maximum number of possible anchors, maximum area of impact across all required infrastructure, maximum quantity of rock dump and its associated area of impact, maximum number of wells, expected vessel movements etc.	Worst case scenarios have been used to assess potential impacts where relevant within the ES.	Worst case scenarios have been used to assess potential impacts where relevant within the ES.	Section 8 - 14
JNCC	The ES should also consider expected maintenance aspects for the Cambo Phase I development and any decommissioning planning/ options as appropriate.	A high-level description of inspection and maintenance for subsea infrastructure and the FPSO have been provided in the ES.	A high-level description of inspection and maintenance for subsea infrastructure and the FPSO have been provided in the ES.	Section 4.5.6
JNCC	It would also be beneficial if the ES contained the maximum realistic disturbance footprint expected by the Cambo Phase I Development, and how the disturbance is distributed across the various designating features of marine protected areas, or other features of nature conservation importance. The expected timescale of impact, including expected recovery times should be discussed, in the context of the site's conservation objectives.	The maximum footprint has been used in assessing physical presence impact.	The maximum footprint of the Cambo field development has been used when assessing physical presence impacts.	Section 8

JNCC	The proposed pipeline route from the Cambo I Development is currently projected to interact with the Faroe Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA). This site has been designated for: * Deep-sea sponge aggregations; * Offshore subtidal sands and gravels; * Ocean quahog aggregations; * Continental slope; * Continental slope channels; * Iceberg plough marks; * Prograding wedges and slide deposits representative of the West Shetland Margin paleo-depositional system Key Geodiversity Area; * Sand wave fields and sediment wave fields representative of the West Shetland Margin contourite deposits Key Geodiversity Area. The ES should contain relevant survey and feature sensitivity information which can be used to assess if the proposed operations are capable of affecting, other than insignificantly, the features for which the site is designated. Sensitivity information can be found on the Features, Activities Sensitivity Tool (FEAST) http://www.marine.scotland.gov.uk/feast/. Any conclusions should be clearly justified and audited within the ES. If the proposed operations are capable of affecting the designating features then the ES should contain an evidence based complete assessment, against the sites conservation objectives and provide details of any mitigation which will be used to minimise impact. The contribution of the Cambo phase I development to the anticipated cumulative impacts effecting the Faroe Shetland Sponge Belt NCMPA should also be considered. The	FEAST tool has been used in relevant impact Sections 9-13 where appropriate.	The proposed Cambo development footprint no longer transits through the Faroe-Shetland Sponge Belt NCMPA. Where appropriate, the FeAST has been consulted as part of the impact assessment process for the Cambo field development.	Section 8 - 14

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
	impacts must be assessed across all relevant features of the site and consider all of the Conservation Objectives.			
JNCC	Information relating to our current understanding of the Faroe Shetland Sponge Belt NCMPA, and feature sensitivities can be found on our website, with recently published updated conservation advice (under the conservation advice tab) http://jncc.defra.gov.uk/page-6479 jncc.defra.gov.uk/files/FSSB_ConsAdvice_April 2018.zip. JNCC strongly recommend that this information is used to support the environmental impact assessment process. Siccar Point Energy may also find guidance within the Nature Conservation Marine Protected Areas: Draft Management Handbook helpful in undertaking the assessment.	The JNCC website has been utilised in producing Section 4. Reference has also been made to two JNCC MPA documents as well.	The proposed Cambo development footprint no longer transits through the Faroe-Shetland Sponge Belt NCMPA. The JNCC website has been utilised in producing Section 5 of the ES (Local Environment).	Section 5
JNCC	West of Shetland is considered an area of importance for marine mammals. JNCC recommends that this is recognised within the ES and that impacts including, but not limited to noise, potential changes in food distribution are considered within the ES.	The importance of the area for marine mammals is recognised and acknowledged as such in the ES. Potential impacts are also assessed in relation to noise and accidental events.	The importance of the area for marine mammals is recognised and acknowledged as such in the ES. Potential impacts are also assessed in relation to noise and accidental events.	Section 5 Section 12 Section 14

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
JNCC	JNCC welcomes the use of the SOSI within the Cambo Phase I Scoping Study. The SOSI was primarily developed to assist in contingency planning by identifying areas where seabirds are likely to be most sensitive to oil pollution by considering factors that make a species more or less sensitive to oil-related impacts. Therefore, when assessing the impacts of accidental events on seabird populations, inclusion of this information is appropriate. We highlight, however, that this index is not intended to inform environmental baselines on seabird populations. We recommend consideration of other data sources when describing the baseline biological environment in the EIA e.g. Kober et al., 2010 and other sources already used within the scoping report. JNCC also recommends that the SOSI is used within the ES to inform the safety case, as required under the Offshore Safety Directive.	Reference has been made to SOSI in the ES. Kober et al., 2010 has been referenced.	Kober et al., 2010 has been referenced, as have other data sources such as Waggitt et al., 2019 to inform the Local Environment (Section 5). SOSI has been referenced in the ES to inform the impact assessment from an accidental release of oil (Section 14).	Section 5 Section 14
JNCC	The use of mitigation to minimise environmental impacts is an important consideration within the environmental impact assessment process. JNCC recommend that any mitigation Siccar Point Energy can commit to using is clearly outlined within the ES and is subsequently incorporated into any subsequent licence conditions, following approval by BEIS.	Commitments have been addressed in the ES.	Proposed mitigation measures are clearly set out in each impact section as well as the Commitments Register.	Section 8 – 14 Appendix 2

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
JNCC	JNCC understand that Siccar Point Energy plan to carry out environmental surveys along the proposed pipeline route and around the proposed production centres. The collection of new survey data can help provide a robust characterisation of the local environment, provide baseline information which can be used to identify and assess impact and reduce the environmental risk of the Cambo phase I development. The ES should outline which new surveys are being undertaken and how they will complement existing environmental survey information. JNCC would welcome further consultation on the development of these survey plans and as discussed on the 23 March 2018, look forward to working with Siccar Point Energy[1] on their development.	SPE met with JNCC on 20th April 2018 to discuss survey planning in further detail. All guidance gratefully received.	Findings from the 2018 and 2025 environmental baseline surveys are presented in the ES.	Section 5
SFF	UK Fishing vessels currently cannot fish below 800 m due to licence (regulatory) restrictions. This is not permanent 'per se' as variations could be applied. Reviews and variations can be changed at any time.	Comment noted.	Comment noted.	N/A
SFF	Fishing activity from foreign fishing fleets occur at depths greater than 800 m e.g. depths greater than 1,000m West of Shetland. These fleets include Spanish, French, German and Faroese vessels.	Comment noted and referenced in the ES.	Comment noted.	Section 5

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
SFF	Communications on oil and gas development activity to the UK fishing fleet via FishSafe. Sea fish handle communication transfer to foreign fishing fleets usually occur every 6 months. There are no guarantees that Foreign vessels are using up to date information regarding seabed obstructions. This is also true of UK vessels but to a much lesser degree.	Comment noted.	Comment noted.	N/A
SFF	SFF requested that during drilling operations a 'log' of fishing vessels in the Cambo area is kept [during 2018 appraisal drilling operations]. SPE to action this as appropriate.	A fishing activity log was kept during 2018 drilling operations, and the results summarised in the ES.	A fishing activity log was kept during 2018 drilling operations, and the results summarised in the ES.	Section 5
SFF	SFF provided some guidance on expectations regarding design of subsea structures in relation to fishing activity. It is advised that any structures installed in 'open water' should be designed to be over-trawlable, whereas structures in the North Sea and inside a 500m safety zone are normally designed as 'fishing friendly' SPE will take this advice onboard and revert to SFF at a later date once the project scope becomes more defined.	No wellhead protection structures are planned due to the water depth in field relative to any potential fishing activity and exclusion zones will be put in place.	Fishing intensity studies have indicated that there is no fishing activity in the Cambo in-field area. On this basis, and as exclusion zones will be established around the wells and in-field infrastructure, there are no wellhead protection structures planned.	Section 4 Section 5
SFF	With reference to the proposed gas export pipeline, SFF queried whether there were any cables in the area.	No charted cables present.	The gas export pipeline now transits northeast towards the planned Rosebank gas export pipeline. In doing so, approximately 3 cable crossings will be required. These are considered in the ES.	Section 4 Section5 Section 8

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
SFF	The SFF queried if there was any particular reason why surface laying the pipeline was being considered.	The ES notes that, based on further analysis, for safety reasons and protection of the gas export pipeline from any potential trawling or other mechanical impacts, up to 45 km of the pipeline (potentially from 800 m water depth to the WOSPS PLEM location) will be jet-trenched.	The revised route for the gas export pipeline now transits northeast towards the planned Rosebank gas export pipeline and will be installed in water depths in excess of 1,000 m. The pipeline will be surface laid in its entirety as, at this depth, there will be no interactions between the pipeline and UK fishing vessels which may be present in the area. Furthermore, surface laying of the pipeline negates the need for trenching operations and increased disturbance of the seabed.	Section 4 Section 5
SFF	The SFF highlighted that there is a lot of fishing activity up and down the deepwater ridge. The load bearings of the pipe need to be able to tackle the 'hit' from any trawling/fishing gear. Pipeline protection needs to be considered.	Pipeline protection has been included in the ES.	The pipeline will be laid at water depths in excess of 1,000 m beyond the permitted limit for UK fishing vessels. Pipeline protection at these depths is not considered to be required.	Section 4 Section 8
SFF	SPE mentioned that a Scoping Report had been produced for consultation with OPRED, JNCC and Marine Scotland. The SFF would welcome the opportunity to provide comment on this report. The SFF will liaise with other relevant fishing organisations as appropriate.	The scoping report was sent to the SFF and comments gratefully received.	N/A	N/A

Origin	Original Scoping Comment / Issues Raised	2021 Response Summary	2026 Response Summary	ES Section
SFF	SFF offered to present a fisheries awareness session to highlight the interactions between various fishing gear and oil industry infrastructure.	SPE[1] gratefully accepts this offer and will action a suitable date for such a presentation to take place at an appropriate time.	Ithaca Energy welcomes the opportunity for further engagement with the SFF regarding the project.	NA
SFF	The anchor pattern has a large footprint however given the locality and the low fishing intensity in the development area we have no further comments at this time.	Comment noted.	Comment noted.	NA
SFF	The proposed surface laid pipelines (65Km and 59Km) would be required to have sufficient loadings to interact with fishing methods that are deployed in the area.	Export pipeline protection is addressed in the ES.	The revised route for the gas export pipeline now transits northeast towards the planned Rosebank gas export pipeline and will be installed in water depths in excess of 1,000 m. At this depth there will be no interactions between the pipeline and UK fishing vessels which may be present in the area	Section 4 Section 8

A.5 Production Profiles for the Cambo Field

Table A.5.1: Average annual production profiles in oilfield units

Year	Highest Production Case Scenario (at least P_{10})						Mid Production Case Scenario						Lowest Production Case Scenario					
	Oil [bbls/d]	Water [bbls/d]	Production Gas [MMscf/d]	F&F [MMscf/d]	Export Gas [MMscf/d]	WI [bbls/d]	Oil [bbls/d]	Water [bbls/d]	Production Gas [MMscf/d]	F&F [MMscf/d]	Export Gas [MMscf/d]	WI [bbls/d]	Oil [bbls/d]	Water [bbls/d]	Production Gas [MMscf/d]	F&F [MMscf/d]	Export Gas [MMscf/d]	WI [bbls/d]
2030	8,125	0	3.9	3.8	0.1	7,307	8,125	0	4.2	4.2	0.0	7,648	8,125	111	3.1	3.0	0.1	8,064
2031	40,500	1,015	18.4	6.6	11.7	44,514	40,500	985	20.3	6.9	13.4	44,517	40,500	4,779	18.6	6.5	12.1	46,613
2032	40,500	3,064	21.3	6.3	14.9	58,500	40,500	3,048	23.5	6.4	17.0	56,299	40,485	13,837	19.3	6.2	13.0	58,500
2033	40,500	5,970	21.4	6.3	15.0	58,500	40,500	8,956	21.9	6.3	15.6	56,635	32,998	30,002	15.4	5.9	9.4	58,500
2034	40,500	11,177	18.9	6.2	12.7	58,500	39,729	19,969	18.2	6.1	12.1	57,971	23,461	39,539	10.3	5.5	4.8	58,500
2035	40,037	20,857	17.7	6.1	11.6	58,500	32,033	30,980	14.5	5.8	8.7	58,500	18,290	44,710	8.0	5.3	2.7	58,500
2036	35,211	27,789	14.9	5.9	9.0	58,500	24,668	38,218	10.7	5.5	5.1	58,500	14,818	48,182	6.2	5.1	1.1	58,500
2037	29,075	33,925	12.1	5.7	6.4	58,500	20,033	41,756	8.4	5.3	3.0	58,500	12,425	50,575	5.2	5.1	0.1	58,500
2038	24,145	38,855	10.0	5.5	4.5	58,500	16,691	44,307	6.8	5.2	1.6	58,500	10,699	52,301	4.5	5.0	0.0	58,500
2039	20,872	42,128	8.5	5.4	3.2	58,500	13,623	46,262	5.2	5.1	0.1	58,500	9,465	53,530	3.9	4.9	0.0	58,500
2040	18,475	44,525	7.6	5.3	2.3	58,500	11,484	47,558	4.1	5.0	0.0	58,500	8,414	53,998	3.6	4.9	0.0	58,500
2041	16,511	46,489	6.8	5.2	1.6	58,500	10,257	48,632	3.7	4.9	0.0	58,500	7,529	54,000	3.2	4.9	0.0	58,500
2042	14,711	48,289	6.0	5.1	0.9	58,500	9,361	49,555	3.4	4.9	0.0	58,500	6,802	54,000	2.9	4.9	0.0	58,500
2043	13,211	49,789	5.2	5.1	0.0	58,500	8,579	50,440	3.2	4.9	0.0	58,500	6,224	54,000	2.7	4.8	0.0	58,500
2044	11,772	50,674	4.5	5.0	0.0	58,500	7,898	51,312	3.1	4.9	0.0	58,500	5,695	54,000	2.4	4.8	0.0	58,500
2045	10,612	50,740	4.1	5.0	0.0	58,500	7,329	51,988	3.0	4.9	0.0	58,500	5,313	54,000	2.2	4.8	0.0	58,500
2046	9,696	50,846	3.7	4.9	0.0	58,500	6,808	52,511	2.8	4.8	0.0	58,500	4,922	54,000	2.0	4.8	0.0	58,500
2047	8,971	51,044	3.4	4.9	0.0	58,500	6,333	52,912	2.6	4.8	0.0	58,500	4,632	54,000	1.9	4.8	0.0	58,500
2048	8,354	51,217	3.2	4.9	0.0	58,500	5,915	53,236	2.5	4.8	0.0	58,500	4,353	54,000	1.7	4.8	0.0	58,500
2049	7,833	51,423	3.0	4.9	0.0	58,500	5,546	53,502	2.3	4.8	0.0	58,500	4,102	54,000	1.6	4.7	0.0	58,500
2050	7,378	51,643	2.9	4.9	0.0	58,500	5,226	53,728	2.1	4.8	0.0	58,500	3,878	54,000	1.5	4.7	0.0	58,500
2051	6,962	51,794	2.7	4.8	0.0	58,500	4,946	53,927	2.0	4.8	0.0	58,500	3,680	54,000	1.4	4.7	0.0	58,500
2052	6,599	51,974	2.5	4.8	0.0	58,500	4,668	53,979	1.9	4.8	0.0	58,500	3,502	54,000	1.3	4.7	0.0	58,500
2053	6,271	52,147	2.4	4.8	0.0	58,500	4,423	54,003	1.8	4.8	0.0	58,500	3,341	54,000	1.2	4.7	0.0	58,500
2054	5,959	52,355	2.2	4.8	0.0	58,500	4,193	53,994	1.6	4.7	0.0	58,500	3,197	54,000	1.2	4.7	0.0	58,500
2055	5,682	52,567	2.1	4.8	0.0	58,500	4,020	54,000	1.6	4.7	0.0	58,500	3,065	54,000	1.1	4.7	0.0	58,500

Notes
bbls = Barrels;
d = Day;
MMscf = Million Standard Cubic Feet;
F&F = Fuel & Flare;
WI = Water Injection.

Table A.5.2: Average annual production profiles in metric units

Year	Highest Production Case Scenario (at least P_{10})							Mid Production Case Scenario							Lowest Production Case Scenario						
	Oil		Water	Production Gas	F&F	Export Gas	WI	Oil		Water	Production Gas	F&F	Export Gas	WI	Oil		Water	Production Gas	F&F	Export Gas	WI
	[m^3/d]	[tonnes/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]	[tonnes/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]	[tonnes/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]	[m^3/d]
2030	1,292	1,179	0	111,825	108,300	3,499	1,162	1,292	1,179	0	119,758	118,926	804	1,216	1,292	1,178	18	87,985	85,057	2,908	1,282
2031	6,439	5,872	161	520,222	188,159	331,942	7,077	6,439	5,871	157	573,414	194,538	378,743	7,077	6,439	5,871	760	526,960	185,168	341,669	7,411
2032	6,439	5,874	487	602,472	179,065	423,267	9,300	6,439	5,871	485	664,844	180,308	482,566	8,951	6,436	5,870	2,200	545,222	176,145	367,461	9,300
2033	6,439	5,875	949	605,418	179,215	426,062	9,300	6,439	5,872	1,424	621,320	178,401	442,774	9,004	5,246	4,786	4,770	434,714	167,109	267,504	9,300
2034	6,439	5,876	1,777	535,395	175,662	359,609	9,300	6,316	5,760	3,175	516,329	173,881	342,328	9,216	3,730	3,402	6,286	291,331	155,484	135,779	9,300
2035	6,365	5,807	3,316	502,578	173,784	328,677	9,300	5,093	4,645	4,925	410,902	165,460	245,346	9,300	2,908	2,652	7,108	225,219	149,783	75,383	9,300
2036	5,598	5,107	4,418	421,550	167,457	253,995	9,300	3,922	3,576	6,076	301,741	156,558	144,289	9,300	2,356	2,148	7,660	176,914	145,759	30,630	9,300
2037	4,622	4,217	5,393	342,736	160,653	182,004	9,300	3,185	2,904	6,639	237,589	151,203	86,331	9,300	1,975	1,802	8,041	146,361	143,131	3,196	9,300
2038	3,839	3,501	6,177	282,655	155,358	127,231	9,300	2,654	2,419	7,044	193,796	147,467	46,284	9,300	1,701	1,551	8,315	126,924	141,366	0	9,300
2039	3,318	3,027	6,698	241,717	151,794	89,867	9,300	2,166	1,975	7,355	147,940	143,756	4,150	9,300	1,505	1,372	8,510	111,832	140,044	0	9,300
2040	2,937	2,679	7,079	215,135	149,358	65,727	9,300	1,826	1,665	7,561	116,049	141,172	0	9,300	1,338	1,220	8,585	100,734	139,005	0	9,300
2041	2,625	2,394	7,391	192,325	147,311	44,970	9,300	1,631	1,487	7,732	103,448	139,981	0	9,300	1,197	1,092	8,585	91,297	138,130	0	9,300
2042	2,339	2,133	7,677	169,524	145,340	24,145	9,300	1,488	1,357	7,878	95,927	139,195	0	9,300	1,081	986	8,585	82,458	137,354	0	9,300
2043	2,100	1,916	7,916	148,006	143,571	0	9,300	1,364	1,244	8,019	90,646	138,573	0	9,300	989	902	8,585	76,217	136,777	0	9,300
2044	1,872	1,708	8,056	127,998	141,908	0	9,300	1,256	1,146	8,158	87,031	138,081	0	9,300	905	826	8,585	68,705	136,158	0	9,300
2045	1,687	1,539	8,067	115,253	140,737	0	9,300	1,165	1,063	8,265	83,701	137,656	0	9,300	845	770	8,585	62,491	135,673	0	9,300
2046	1,542	1,406	8,084	104,975	139,803	0	9,300	1,082	987	8,348	79,646	137,215	0	9,300	782	714	8,585	57,501	135,244	0	9,300
2047	1,426	1,301	8,115	97,170	139,080	0	9,300	1,007	918	8,412	74,888	136,760	0	9,300	736	672	8,585	52,523	134,862	0	9,300
2048	1,328	1,212	8,143	90,941	138,486	0	9,300	940	858	8,464	69,989	136,322	0	9,300	692	631	8,585	48,439	134,528	0	9,300
2049	1,245	1,136	8,175	85,487	137,975	0	9,300	882	804	8,506	64,654	135,887	0	9,300	652	595	8,585	44,940	134,239	0	9,300
2050	1,173	1,070	8,210	80,727	137,528	0	9,300	831	758	8,542	59,983	135,507	0	9,300	617	562	8,585	41,609	133,970	0	9,300
2051	1,107	1,010	8,234	76,051	137,104	0	9,300	786	717	8,574	56,205	135,189	0	9,300	585	534	8,585	38,771	133,737	0	9,300
2052	1,049	957	8,263	71,479	136,708	0	9,300	742	677	8,582	52,729	134,887	0	9,300	557	508	8,585	36,480	133,541	0	9,300
2053	997	910	8,290	67,186	136,343	0	9,300	703	642	8,585	49,589	134,619	0	9,300	531	485	8,585	34,508	133,369	0	9,300
2054	947	865	8,324	63,445	136,014	0	9,300	667	608	8,584	46,681	134,368	0	9,300	508	464	8,585	32,809	133,218	0	9,300
2055	903	824	8,357	60,151	135,722	0	9,300	639	583	8,585	44,244	134,167	0	9,300	487	445	8,585	31,288	133,082	0	9,300

Notes
d = Day;
F&F = Fuel & Flare;
WI = Water Injection;
MMt = Million tonnes

Table A.5.3: Daily oil in water discharges

Year	High Case (at least P_{10}) Scenario			Mid Case Scenario			Low Case Scenario		
	Water [bbls/day]	Oil Discharged		Water [bbls/day]	Oil Discharged		Water [bbls/day]	Oil Discharged	
		[kg/day]	[tonnes/day]		[kg/day]	[tonnes/day]		[kg/day]	[tonnes/day]
2030	0	0.0	0.0000	0	0.0	0.0000	111	0.3	0.0003
2031	1,015	2.4	0.0024	985	2.3	0.0023	4,779	11.4	0.0114
2032	3,064	7.3	0.0073	3,048	7.3	0.0073	13,837	33.0	0.0330
2033	5,970	14.2	0.0142	8,956	21.4	0.0214	30,002	71.5	0.0715
2034	11,177	26.7	0.0267	19,969	47.6	0.0476	39,539	94.3	0.0943
2035	20,857	49.7	0.0497	30,980	73.9	0.0739	44,710	106.6	0.1066
2036	27,789	66.3	0.0663	38,218	91.1	0.0911	48,182	114.9	0.1149
2037	33,925	80.9	0.0809	41,756	99.6	0.0996	50,575	120.6	0.1206
2038	38,855	92.7	0.0927	44,307	105.7	0.1057	52,301	124.7	0.1247
2039	42,128	100.5	0.1005	46,262	110.3	0.1103	53,530	127.7	0.1277
2040	44,525	106.2	0.1062	47,558	113.4	0.1134	53,998	128.8	0.1288
2041	46,489	110.9	0.1109	48,632	116.0	0.1160	54,000	128.8	0.1288
2042	48,289	115.2	0.1152	49,555	118.2	0.1182	54,000	128.8	0.1288
2043	49,789	118.7	0.1187	50,440	120.3	0.1203	54,000	128.8	0.1288
2044	50,674	120.8	0.1208	51,312	122.4	0.1224	54,000	128.8	0.1288
2045	50,740	121.0	0.1210	51,988	124.0	0.1240	54,000	128.8	0.1288
2046	50,846	121.3	0.1213	52,511	125.2	0.1252	54,000	128.8	0.1288
2047	51,044	121.7	0.1217	52,912	126.2	0.1262	54,000	128.8	0.1288
2048	51,217	122.1	0.1221	53,236	127.0	0.1270	54,000	128.8	0.1288
2049	51,423	122.6	0.1226	53,502	127.6	0.1276	54,000	128.8	0.1288
2050	51,643	123.2	0.1232	53,728	128.1	0.1281	54,000	128.8	0.1288
2051	51,794	123.5	0.1235	53,927	128.6	0.1286	54,000	128.8	0.1288
2052	51,974	123.9	0.1239	53,979	128.7	0.1287	54,000	128.8	0.1288
2053	52,147	124.4	0.1244	54,003	128.8	0.1288	54,000	128.8	0.1288
2054	52,355	124.9	0.1249	53,994	128.8	0.1288	54,000	128.8	0.1288
2055	52,567	125.4	0.1254	54,000	128.8	0.1288	54,000	128.8	0.1288

Notes
bbls = Barrels.